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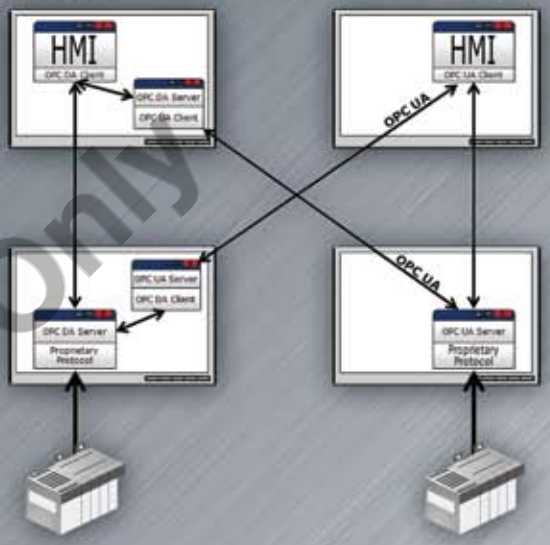

The great debate:
Slip control versus field-oriented control

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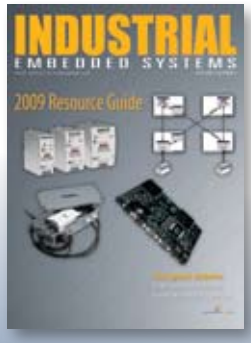

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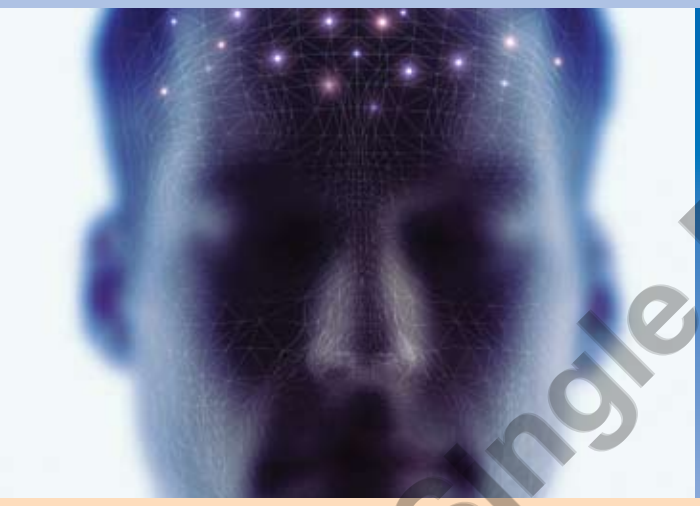

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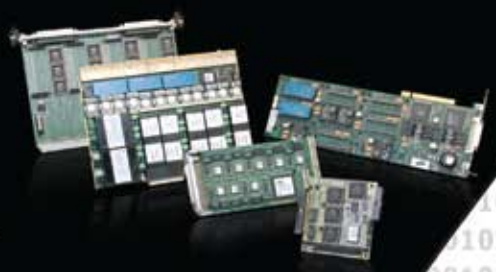

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foreword >> thinking

By Don Dingee

We need silicon, not just shovels

Some public relations type came up with the term "shovel-ready" to draw the image that construction projects are ready to start immediately. We all want our money to go right to work. I'm not against that at all. But it's simply not enough.

Our competitive advantage isn't construction. I don't want to minimize the importance of construction and the planning and talent that go into it. Done right, wonderful things can be built. Done wrong, structures can fail and cause damage and even loss of life. Construction is not trivial, and it is necessary. I don't think there will be much argument about the United States needing new roads, bridges, public transportation, water and waste management, and other infrastructure projects that are essential to our future.

But in a global economy, construction isn't something that only we can do. There are lots of firms worldwide that can muster the planning, equipment, muscle, and project management that can build anything. In fact, there are some things that are too easy to build. I drive down the street here in Arizona, and there are more new construction projects for shopping and light industrial buildings than ever, right next to vacant buildings. It really doesn't seem like the best use of resources, but economics cause funny things to happen.

If change is what we want

We hear so much about change these days. Here's one change that needs to happen: It's about time economics cause something more meaningful to be built – a better way to connect people with information. Connecting things, sharing information, and freeing people to be more creative and innovative will make for a competitive advantage in the future, and the firms and countries that seize this opportunity during this downturn will come out ahead.

I'm not talking about trivial fads, like creating a potted plant that can call for water over Twitter or anything else that just blasts out info because it can. I'm talking about really connecting things in a way that improves efficiency, saves money and resources, and enhances our quality of life.

For instance, our electrical power grid is a massive opportunity ready to become more intelligent. Every second, all electricity generated has to be consumed or it is lost in the system. A smart grid could not only tie all producers to all consumers (and even all devices used by those consumers) and exactly measure demand, but it could also forecast and control demand to match supply much more precisely and efficiently, saving money and resources.

Creating a truly smart grid doesn't seem as elegant as, say, building a bridge. We send 10,000 construction workers out, a couple years later we have a bridge, and everyone thinks that's cool. We send 10,000 electrical workers out to install smart meters in homes and businesses, a couple years later we have 4 million connected electrical consumers in a region, and everyone wonders what really happened. It's a long-term investment with incremental return that has to be aggregated over millions of users.

Now extend that idea to not just the electrical grid, but every device consuming resources: cars, offices, machine tools, potted plants, whatever. Knowing how much of a certain resource is needed at an exact spot at a given time will save money and resources in the long run.

Then silicon is what we need

To do this, we need so much more than just shovels – we need silicon and software. Embedding intelligence into our devices will not only create exciting new jobs, but will also create lasting change and help safeguard jobs in the future.

We've got some intelligent ideas inside this issue, with looks at motor control from Freescale Semiconductor and Altera, software ideas from the OPC Training Institute and QNX Software Systems, our usual Editor's Choice selections, and a wide range of offerings from many featured companies in our Resource Guide section.

If you have ideas or things you'd like to see, I'm always available at ddingee@opensystemsmedia.com.

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The great debate: Slip control versus field-oriented control

By Dave Wilson

Author's note: *With last year's hard-fought election still in recent memory, the last thing you might want to read is an article reminiscent of that political process. However, I think we can have a little fun with this topic by casting two competing motor control technologies as candidates, pitting them against each other in a heated debate, and letting you decide which technology wins.*

Moderator: Good evening ladies and gentlemen, and welcome to this final debate between our two motor control candidates. To your left, please welcome the incumbent technology, Constant Slip Control, or simply "Slip" as he prefers to be called. And on the right, please meet our challenger, Field-Oriented Control, better known by his nickname, "Vector."

I would like to address my first question to Slip. Considering that you are "slipping" so far behind in the motor "poles," do you really believe you are a serious contender for variable speed drive applications?

Slip: Despite my opponent's current lead in the "poles," let me make one thing perfectly clear: I bring many years of tested experience to this discussion and represent the preferred choice of design engineers worldwide when it comes to controlling AC induction motors. My opponent makes many promises, including increased transient response. But are we ready to embrace the risky schemes represented by these claims? By the end of this debate, it will become apparent why I represent the most economical, robust, and energy-efficient choice for induction motor control.

Moderator: Is that true, Vector? Do you really represent a more risky approach?

Vector: Not at all. You can obviously see that this is a desperate attempt by my opponent to smear and distort my extensive record, which reveals my unconventional approach to motor control. Thousands of motor control designers around the world cannot all be wrong. As microcontroller and Digital Signal Controller (DSC) costs continue to drop, expect to see more and more motor control systems benefit from the advantages I offer over my opponent, which will become evident by the end of the evening. With a long history of transforming motor designs around the world, I am clearly the maverick you need to buck the failed policies of the past and lead us confidently into the future. In fact, it has been said that I am perhaps the most significant discovery in the motor control world since the AC induction motor itself …

Slip: I have worked with induction motors for many years. Induction motors are friends of mine. And you, sir, are *no* AC induction motor!

Also, you *do* represent a risky approach, compared to the simplicity of control that is the cornerstone of my campaign. To prove this, please refer to Exhibit 1, which shows a block diagram of a variable speed AC drive utilizing slip control. The system shown is based on voltage mode control, but current mode systems are also popular.

To keep from overfluxing the machine during transient conditions, the voltage is limited by a predetermined V/Hz law, as shown by the voltage limiter block. Instead of dual current loops

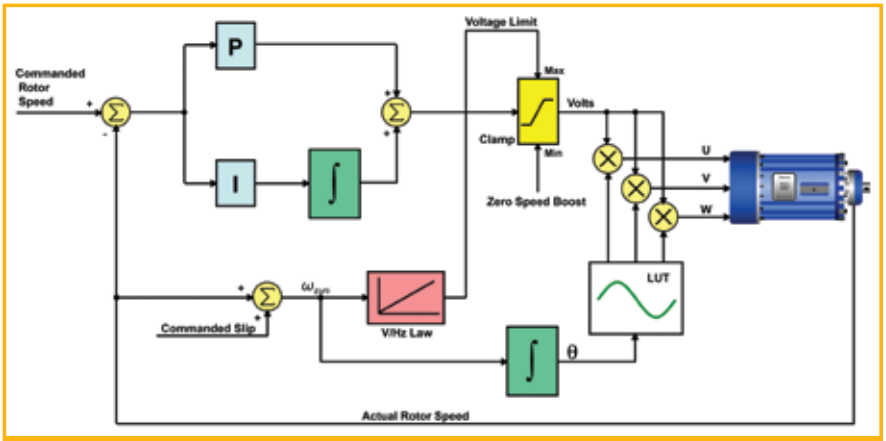

Exhibit 1 | A variable speed controller utilizing a constant slip approach can be adjusted to maximize efficiency.

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with precarious frame transformations, complicated flux estimators, and risky sensorless back EMF observers, we see a kinder, gentler control system where motor voltage and frequency represent the controlled variables. The desired slip is supplied directly as an input to the system, which can be dynamically and optimally adjusted to maximize torque, efficiency, power factor, torque per amp – you name it.

In this particular system, voltage is controlled independently from frequency to provide optimum defluxing of the machine under light loads to save energy. The energy savings resulting from this approach compared to the rated flux control of my opponent are shown in Exhibit 2, where the slip in my system has been adjusted to optimize motor efficiency. In both cases, the same 3 HP induction motor model is used.

Given that motors consume more than 50 percent of all electricity generated, can we really afford the risky and wasteful energy-spending policies advocated by my opponent?

Vector: There you go again. You should really check your facts before you start talking about my energy plan.

My opponent has compared the energy savings of his plan to a field-oriented system operating with *rated* flux. He either doesn't know or doesn't want *you* to know that the same energy savings can be obtained in a field-oriented system by simply lowering the d axis current, which

	Field-oriented control with rated flux	Constant slip control with reduced flux
Operating speed	120 Radians/sec	120 Radians/sec
Operating torque	1 N-M (8% rated)	1 N-M (8% rated)
Slip	0.5 Radians/sec	4.95 Radians/sec
Power factor	0.2	0.78
RMS current	1.82 A	1.01 A
RMS voltage (line-line)	286 V	97 V
Rotor flux linkage	1.14 Weber-Turns	0.37 Weber-Turns
Stator copper loss	17.7 W	5.47 W
Rotor copper loss	0.25 W	2.48 W
Iron core loss (est.)	41.0 W	4.39 W
Total losses	58.9 W	12.3 W

Exhibit 2 | A 460 V, 3-phase, 3 HP motor demonstrates better energy-related performance characteristics using constant slip control with reduced flux compared to field-oriented control operating at rated flux.

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directly reduces the machine flux. In Exhibit 3, we see a field-oriented system where the motor flux *and* motor torque can be controlled independently, much like what can be done in a DC machine with a separate field winding.

My opponent cannot directly control motor flux; he can only affect it indirectly by changing voltage. He also mentioned that various values of slip can be commanded to optimize different motor operating parameters, including efficiency. Well, it turns out that the desired steady-state slip of an induction motor can just as easily be set in a field-oriented system by adjusting the ratio of d and q axis stator currents as shown in the following equation, where R_r and L_r are rotor resistance and rotor inductance, respectively:

$$\omega_{slip}\,(rad/sec) = \frac{i_{sq} R_r}{i_{sd} L_r}$$

So, everything my opponent can do, I can do better. But what he failed to tell you is that when you reduce the flux to increase efficiency, it's like putting the motor to sleep. This significantly increases its susceptibility to sudden or unexpected torque perturbations, as shown in Exhibit 4.

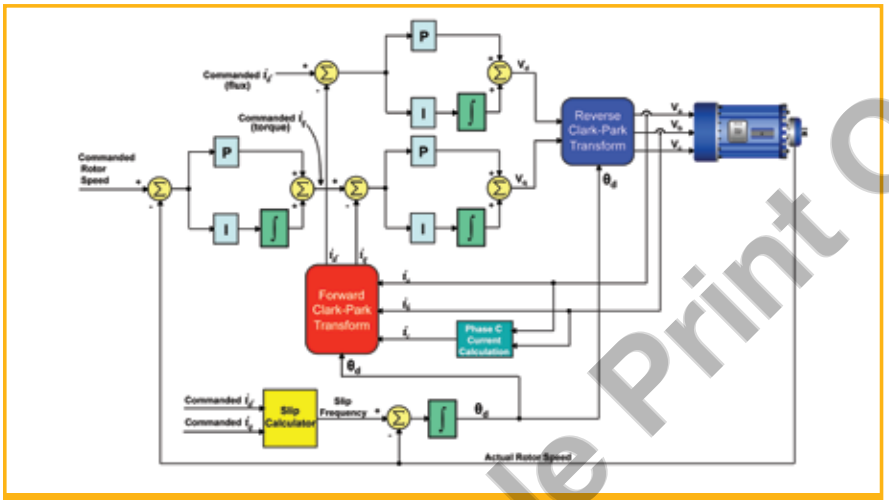

Exhibit 3 | Motor flux and motor torque can be controlled independently in a variable speed control system utilizing field-oriented control.

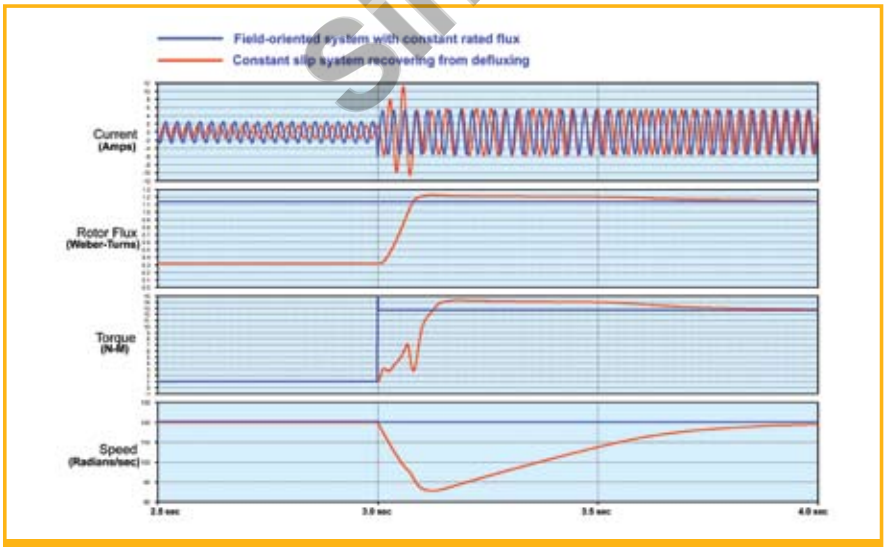

Exhibit 4 | Simulation results of torque step response from 1 N-M load to rated load (12.6 N-M) show the 460 V, 3-phase, 3 HP motor's susceptibility to torque perturbations. (Commanded speed = 120 Radians/sec.)

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It can take hundreds of milliseconds to get the motor to wake up and get the flux reestablished. In some cases, you can even stall the motor. That's why many designers leave the flux at its rated value if fast transient response is needed over a wide torque range.

But I can understand why my opponent doesn't want to talk about transient response – because constant slip control is based on a slower, steady-state model of an induction motor. As much as he would like to dress up his performance in this area, he can't. You can put lipstick on a pig, but it's still a pig. Fast transient response represents a significant advantage over my opponent's failed control policies, which in the past required DC motors to be used if fast response was needed.

Slip: First, let me address the transient response issue. It's way overrated. Sure, you occasionally run into a rare application that needs lightning-fast torque response. But in most cases, once you have it, you spend the rest of your design time trying to mitigate its effects. Fast torque response can translate into high levels of jerk in your system, which can cause acoustic noise and premature mechanical wear.

My dear ol' grandma always used to say, "Why pay for a 1 GHz op-amp when a 1 MHz op-amp will do the job?" Take a washing machine, for example. With all of the mass associated with a loaded drum, why in the world would you want or need super-fast torque response? All of that extra bandwidth will only get you into trouble. It's very difficult to tame and could potentially lead to instability problems in your motor control system down the road.

But I think this whole discussion about transient response is an attempt to take the focus off of the real issue. Over my desk I have a sign that says, "It's the economy, stupid." Why would anyone pay for the expensive DSP required to do field-oriented control when you can meet your requirements with slip control running on a processor that costs half as much? Take a look at Exhibit 5, which shows how a slip control system can be implemented on a simple 8-bit processor.

My opponent is eager to point out that the cost of DSCs is dropping. But a simple 8-bit processor with a von Neumann architecture will *always* be proportionally less expensive than a 16-bit machine based on a Harvard architecture with multiple internal buses. With our economy in such bad shape, can your design budget really justify this kind of lavish pork barrel spending?

Vector: My opponent seems anxious to talk about the economy. OK then, let's talk about the economy. Exhibit 6 shows a field-oriented system that utilizes a Freescale DSC. My opponent mentioned

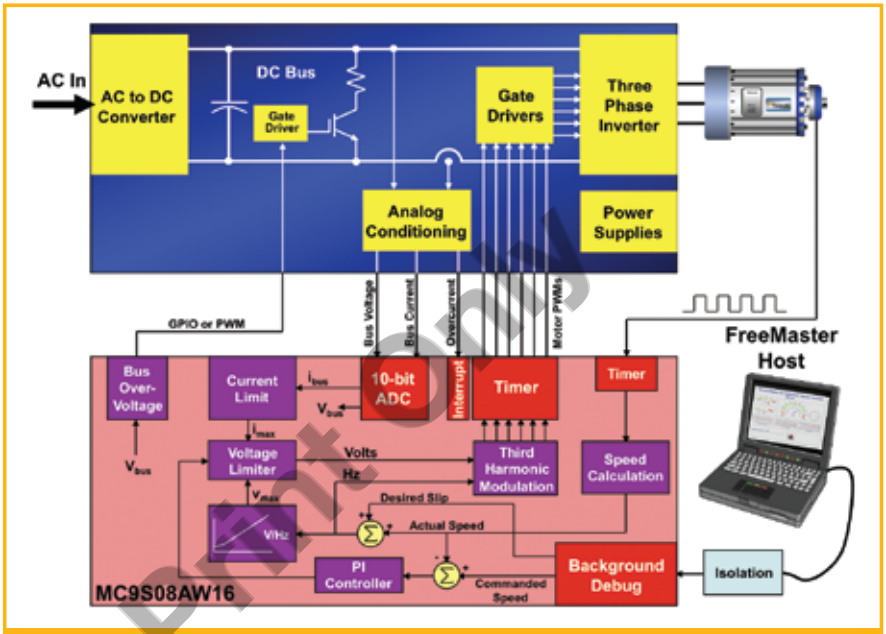

Exhibit 5 | Implementing an 8-bit processor such as the Freescale MC9S08AW16 in a slip controller is less expensive than implementing a 16-bit processor.

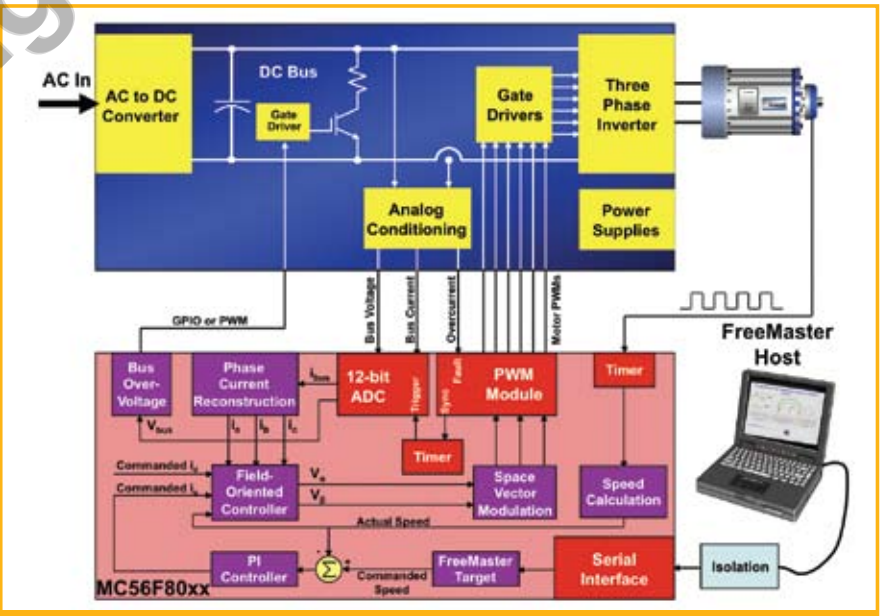

Exhibit 6 | A field-oriented control system with a Freescale MC56F80xx 16-bit DSC processor offers a more economical choice from a system perspective.

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the lower processor cost associated with slip control. But I maintain that the *system* cost is more important when considering your design budget. Notice the hardware similarity between our two designs when you compare Exhibit 6 with Exhibit 5.

The processor cost in these systems, as a proportion of the total system cost, is typically somewhere between 2 and 10 percent, depending on the motor drive horsepower rating. So the processor cost ratio that my opponent loves to cite has very little impact on total system cost. On the other hand, the selected processor and control topologies have a huge impact on system performance. So, from a system perspective, field-oriented control represents the best economical choice.

Another issue my opponent doesn't like to talk about is other motor topologies. I realize that tonight's debate is focused on AC induction machines. But before you vote on which control technique is best for your application, consider this: Many of the library routines that comprise field-oriented control can easily be ported over to other motor topologies. Slip routines only work with induction motors. As software resources become more precious, can you really afford to rewrite your motor control algorithms every time you choose a different motor type? Whether my opponent will admit it or not, I bring a new level of standardization to the motor control industry, representing the hope and change we can believe in for the future.

Finally, I'm getting tired of the accusations that my approach is "risky." This is simply an attempt by my opponent to cover up the failed control policies of his past. I'm going to say this again: I have not had any relations with any motor that were considered risky in nature. Field-oriented control is *not* risky. It is well understood by almost everyone in the motor control community. Even Joe the Plumber could do it! Field-oriented libraries and control blocks are readily available from most semiconductor suppliers, including Freescale Semiconductor at www.freescale.com/motorcontrol.

Moderator: Slip, you have one minute for rebuttal.

Slip: Field-oriented control or vector control *is* risky. It's clearly more complicated and requires a higher level of motor control technical savvy than I do.

But let me go back to the economy for a moment. A slip-controlled system is cheaper than a vector-controlled system. It's just true. We can argue about how much cheaper, but that's not the point. Shouldn't the responsibility of every design engineer be to design the most robust system that meets the required specs for the lowest possible cost? This is especially true for high-volume applications. When multiplied by the compounding effect of high-volume manufacturing, the cost savings per system result in quite a stimulus package for your company. But I do agree with my opponent's comments about Freescale. They can handle both of us.

Moderator: Well, what do you know! We finally found something you both can agree on. Unfortunately, gentlemen, that's all the time we have for tonight's debate. I want to thank each of you for sharing your perspectives on this important topic. I also would like to thank the audience for attending our debate this evening. Finally, thanks to *Industrial Embedded Systems* for sponsoring tonight's discussion. IES

Dave Wilson *is motion products specialist at Freescale Semiconductor, based in Milwaukee, Wisconsin. He has 30 years of experience working on projects ranging from nuclear pulse processing to artificial intelligence pattern recognition, and has designed motor control systems as simple as trigger controls for power tools and as complex as a six-axis DSP servo stage controller for a scanning electron microscope. He is also the author of several articles, patents, and conference papers related to motor control. Dave holds a BSEE from John Brown University and an MSEE from the University of Wisconsin.*

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FPGAs enable energy-efficient motor control

By Jason Chiang

Siemens press picture

Motor control strategies vary according to the type of motor and the control algorithms used. To build an adaptable motor controller, an FPGA provides a flexible platform as a starting point to which designers can add the necessary IP to suit their needs.

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Motor control is at the heart of many of today's industrial automation and motion/drive control applications. Industrial systems and applications are becoming increasingly complex, and designers must support a steadily growing number of features and options to be able to compete in the marketplace. For example, a product must support multiple Industrial Ethernet and fieldbus standards for maximum market coverage. Industrial systems designers can leverage the falling price of processing power to deliver higher-performance drives at lower costs, but competition is fierce and the pressure to reduce time to market is continually increasing.

These market pressures demand that designers implement flexible platforms to create more efficient factories. Factory-wide information systems, control networks, and manufacturing systems, especially those that deploy flexible motion/drive control devices, can be quickly and inexpensively reconfigured for new applications while maintaining a high degree of system interoperability using Ethernet and fieldbus technologies for efficient factory and office communications.

The case for FPGAs

For years, industrial motor control applications used general-purpose electronic devices such as microcontrollers (MCUs) and DSPs. These devices are designed with fixed hardware, leaving software as the only method for designers to update designs and limiting the development of application-specific functions.

In comparison, FPGAs can integrate processor, Industrial Ethernet/fieldbus standards, custom motor interfaces, and DSP functions in one device. FPGAs give designers the freedom to create custom functions completely adapted to their specific application requirements by enabling both hardware and software customization. FPGAs provide the capability to implement functions in hardware, accelerating performance

and simplifying the software porting effort. This additional freedom opens up new avenues of enhanced system performance, especially for motor control energy efficiency.

The following examples show how industrial systems designers can take advantage of FPGA technology and motor control Intellectual Property (IP) to design the next generation of motor control applications with the required functions fully integrated on a single FPGA.

Motor control basics

The increase in industrial energy efficiency during the past few years is largely due to a change in motor control technology. Using a power converter-based variable speed motor drive makes it possible to save up to 88 percent more energy than the previous generation of motor control applications.

The function of the motor controller is to limit the motor's output. A digital speed controller does this by controlling the motor's electrical drive, minimizing overall energy consumption and reducing wear and tear on the motor's mechanical parts. The quality of the design in terms of energy consumption is fundamental to meet market expectations, be cost competitive over the product's lifetime, and comply with environmental and power utility regulations.

Systems and techniques in industrial applications

Motor control systems are at the core of machine control, production, assembly, packaging, robotics, computer numeric control machine tools, and printing. Motor control techniques depend on the type of motor being used. The most common types of motors used in these applications are brushless DC, stepper, AC synchronous, and AC induction.

Two types of motor control systems are typically used in industrial applications today. In a *distributed drive control system,* the motor controller performs all the motion control calculations (speed, velocity, position) and implements a local feedback loop to control the associated motor. These motor controllers (or drives) may communicate with a Programmable Logic Controller (PLC) across a fieldbus or non-real-time Ethernet bus. In a *centralized drive control system,* the motor controller communicates with the PLC using fast real-time Ethernet, making it possible to expand the feedback loop right back to the PLC. This means that a high-performance PLC can perform all the motion calculations, thus enabling the use of simpler and lower-cost motor controllers.

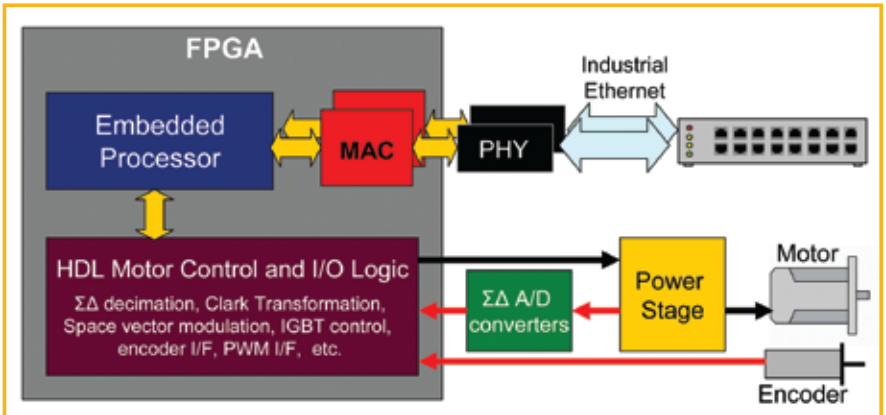

Figure 1 | An FPGA-based motor control system allows designers to create custom functions fully integrated on a single FPGA.

> "The quality of the design in terms of energy consumption is fundamental to meet market expectations, be cost competitive over the product's lifetime, and comply with environmental and power utility regulations."

Benefits of using FPGAs and custom IP

Motor control is a nonlinear and time-varying parameter application. An efficient motor controller demands large amounts of computing power due to the inherently fast dynamics of current flow in the motor and control electronics. Many of today's MCU/DSP devices implement motor control using a simplistic software control loop and a generic one-size-fits-all Pulse-Width Modulation (PWM) block. However, this kind of system architecture cannot provide the optimal power, performance, or integration needed for efficient motor control applications.

Using FPGA devices offers advantages in power efficiency, performance, safety, reliability, system cost, system integration, and implementation flexibility. Figure 1 shows an example of an FPGA-based integrated motor control system.

Power advantages

A central part of any current control strategy is actuating the voltage command using one of many PWM techniques. A PWM technique controls the power-converter transistor states to meet the time-average value of the voltage command. These techniques can reduce losses in the motor and power converter while optimizing the voltage utilization of the DC bus.

The true advantage of using FPGAs is the ability to customize what was previously fixed generic hardware in MCUs or DSPs. In FPGAs the standard PWM block found in an MCU- or DSP-based motor control chip can be replaced by an application-specific PWM IP core optimized for performance and energy efficiency based on individual motor parameters.

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Figure 2 shows a reduction of nearly 50 percent in the total harmonic distortion at a high modulation index using an optimized PWM in an FPGA instead of a standard PWM as used in MCUs or DSPs. This more accurate control reduces time-harmonic losses in the motor, reduces audible noise, and increases global motor reliability.

Performance, safety, reliability, and system cost advantages

The hardware programmability of FPGAs enables designers to easily implement dedicated high-performance logic circuits. Compared to software running on generic MCUs or DSP blocks, using dedicated logic circuits for motor current and torque control allows the motor control loop to operate at much higher frequencies. This also enables the motor controller to extract critical information about the motor's health during its operation, which then can be sent to the main application controller to notify the user about the risk of motor failure.

FPGAs also provide system cost advantages. One benefit of using FPGAs to increase performance in motor control applications is their ability to provide greater flexibility in arranging components and additional functions, for example, integrating computing-intensive functions (such as DSP blocks) to run parallel to the main control scheme. Such functions may be adaptive, with real-time motor parameters and state estimations used to increase motor control performance and allowed to run either with a feedback loop or without speed or position transducers (sensorless operation). An example would be to use advanced DSP techniques in hardware for measurement signal conditioning, minimizing the effort to port optimized DSP software from one platform to the next.

Integration and implementation advantages

In FPGAs, the hardware system design process is completely different from that of discrete components. In the case of Altera's devices, every step of integration is performed within the Quartus II development software, an electronics design automation application that enables the designer to integrate and test system component operations in a completely virtual environment. In this way, the industrial systems designer can start a design from scratch and have a complete operational system in a matter of minutes. In addition, designers can reduce the number of components used, decrease system complexity, increase system reliability (due to less system components), and allow for customizable motor system configurations that fit every design's performance and price point.

Motor control IP is designed to provide a very high-performance interchangeable platform. The practical motor control IP for an application is achieved by selecting and integrating the right combination of IP. FPGAs are flexible and can support many types of communications protocols, motor control IP, and industrial I/O interfaces on one device or platform.

Implementing such functions on MCUs or DSP devices may not be possible or

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- 3.5" ECX Intel® Atom™ processor with FSB 533MHz
- Intel® 945GSE chipset
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- 4 USB 2.0 ports and 6 COM ports
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SBC86836
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might force the designer to compromise on either motor control performance or system performance. In comparison, these functions are completely independent on an FPGA as they can run in parallel in the programmable logic hardware. An FPGA-based motor controller offers completely deterministic performance and enhanced product reliability compared to the serial instruction-execution approaches of MCUs or DSPs.

Another advantage of implementing the motor control IP (and network connectivity) on the FPGA is that it mitigates the risk of product obsolescence. With long product life cycles, FPGAs are built with industrial longevity, system flexibility, and reliability in mind. Designers can modify their systems or migrate to new generations of FPGAs with ease. Contrast this methodology to MCUs or DSPs, which require intensive software resources and involve long development cycles when moving to a new processor architecture to update any hardware features.

FPGAs mean more flexibility

FPGA-based systems offer industrial applications flexibility and productivity benefits that cannot be found in MCU- or DSP-based systems. These devices increase system performance by performing timing-critical tasks in hardware while adding system flexibility, leading to fewer redesigns and enabling designers to deploy their products sooner than traditional MCU- and DSP-based designs. Using FPGAs in motor control applications, designers can easily adapt to their specific application requirements. IES

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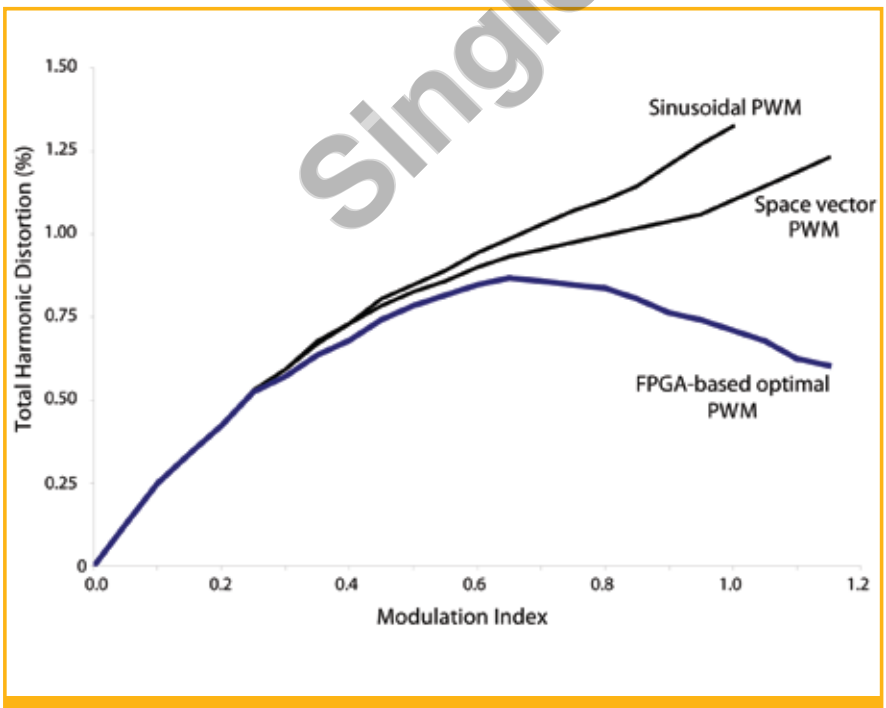

Figure 2 | FPGA-based motor control reduces total harmonic distortion by 50 percent compared to MCU-based motor control. (Source: Alizem)

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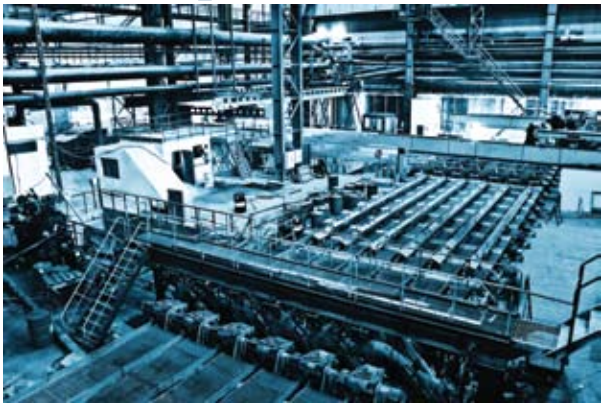

OPC UA, seen through the eyes of users

By Randy Kondor

OPC Unified Architecture (UA) represents the OPC Foundation's most recent set of specifications for process control and automation system interconnectivity. Randy explains OPC UA from the perspective of those who will benefit most from this connectivity: end users.

OPC is an industrial communication standard that allows manufacturers to use data to optimize production, make operation decisions quickly, and generate reports. OPC enables plants to automate data transfers from a control system such as a Programmable Logic Controller (PLC), distributed control system, or analyzer to an industrial software application such as a Human Machine Interface (HMI), historian, production system, or management system.

OPC is typically found in Level 3 and higher networks. Thus, OPC transfers process control data between the control (Level 2) network and the operations/manufacturing (Level 3) network. It also exchanges data between the operations/manufacturing network and the business (Level 4) network. This is depicted in Figure 1. In essence, OPC is the Modbus of the new century. It is not a replacement for low-level communication standards such as 4 to 20 mA, HART, PROFIBUS, or Foundation Fieldbus. Instead, organizations use OPC in high-level communication.

Note that OPC is no longer an acronym. When OPC was first released in 1996, it served as an acronym for OLE for Process Control and was restricted to the Windows Operating System (OS). OPC is now available on other OSs and enjoys significant adoption outside of process control. So the original name OLE for Process Control is no longer appropriate, and OPC no longer stands for anything. OPC is just OPC.

The first form of OPC (now called *Classic OPC*) relied on Distributed Component Object Model (DCOM) for its data transportation. DCOM was very powerful and versatile but posed a problem for those who did not understand how to configure it. Instead of DCOM, OPC UA relies on Web services for its data transportation. OPC UA also uses objects to help with data description. All this will ensure that OPC UA will be even better suited to penetrate the entire plant enterprise. Of course, with all the new connectivity that OPC UA offers, the new challenge will be system security.

Moving to Web services

The change to Web services in OPC UA is something most end users will notice immediately. Two of the biggest advantages for Web services are ease of communication between networks and independence from specific OSs. The challenge for the plant itself will be implementing security to keep data safe.

Perhaps the biggest technical advantage of Web services is that they enable OPC to communicate over a single port using a protocol that most firewalls will allow

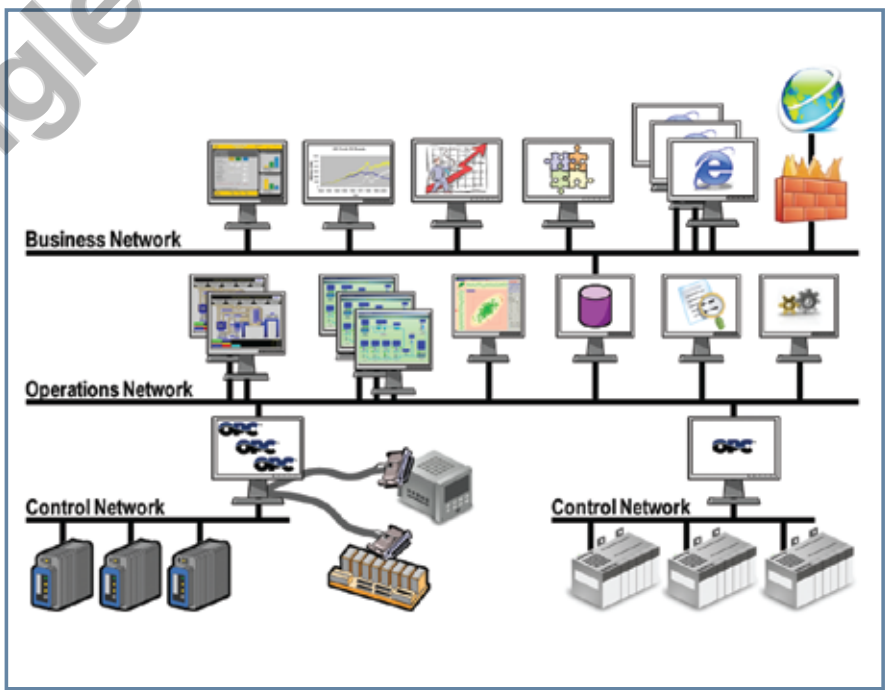

Figure 1 | OPC exchanges data between the control and operations/manufacturing networks and between the operations/manufacturing and business networks.

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to pass by default. This should make it easier for integrators to set up a system for communication between networks. Many firewalls are already configured to let Web traffic pass across port 80. This will make it easier for IT to open the ports necessary to implement OPC communication. Previously, DCOM required multiple ports to establish communication. While this was possible to configure, a significant portion of automation personnel did not take the time to learn how to do it. Nevertheless, opening port 80 releases communication for a plethora of applications, not just those needed for operations, so emphasis on security will be required immediately.

In addition, Web services are not bound to any specific OS. Thus, vendors will have an easier time implementing OPC servers on their automation hardware and non-Windows OSs. Vendors are already working on PLCs that include an embedded native OPC server that does not require an external computer. However, this implementation might not be as simple as it seems because automation applications (HMI, historian, automation and process control, and others) typically require a PC anyway. Nevertheless, it would be possible to have a PLC communicate with a software application using OPC without requiring an intermediate computer that uses Windows.

Object-oriented data model

Classic OPC has a fairly simple data model. Each of the OPC specifications handles a different aspect of the data. For example, the OPC Data Access (DA) specification communicates real-time values; the OPC Historical Data Access (HDA) specification communicates archived values; the OPC Alarms and Events (A&E) specification communicates various process and system events such as a temperature that exceeds a prespecified limit; and so on. In addition, Classic OPC implements each specification separately, essentially in a different executable. Thus, it is time-consuming for end users to match item names with real-time data and item names with historical data. Even worse, automated applications may not be able to do it at all.

OPC UA provides a unified data model, shown in Figure 2. Thus, when an application uses OPC UA to send a temperature reading, the receiver can retrieve the real-time value, any associated historical values, and even alarms and events. All this data is available from pointing at a single OPC item. The OPC server can associate all the data together so that the OPC client does not need to redo the association work.

For example, in DCOM-based OPC, end users interested in a pressure reading would have to point to the OPC DA server to look at the real-time value. Then they would have to point to an OPC HDA server to trend the pressure over the past shift. If they wanted to take a look at associated events, they would have to point to the OPC A&E server. But with OPC UA, end users can simply point to a pressure reading, view its real-time value, look at the past shift's trend (historical data), and view all the associated events by connecting to a single OPC UA server.

OPC UA also provides the ability to create more complex objects. For example, engineers could create a pump composed of various temperature, level, pressure, flow, and vibration readings. Included would be the history of all values as well as a picture of the pump. Engineers could even associate process and instrumentation schematic diagrams and maintenance orders. This presents a powerful mechanism for integrators from various companies to share data without having to recreate it in their different proprietary software applications.

Shop floor to top floor: OPC to the enterprise

OPC UA introduces an object model to industrial data, and Web services will enable OPC applications to transport the data across firewalls, networks, and the Internet. A variety of applications will be able to supply the enterprise with data. An HMI will be able to pass equipment events to the maintenance system. The historian will be able to pass calculations to various engineering systems. As well, inventory management systems will be able to easily obtain production figures directly from automation equipment.

Plant floor data will finally find its way to the business LAN and enable a variety

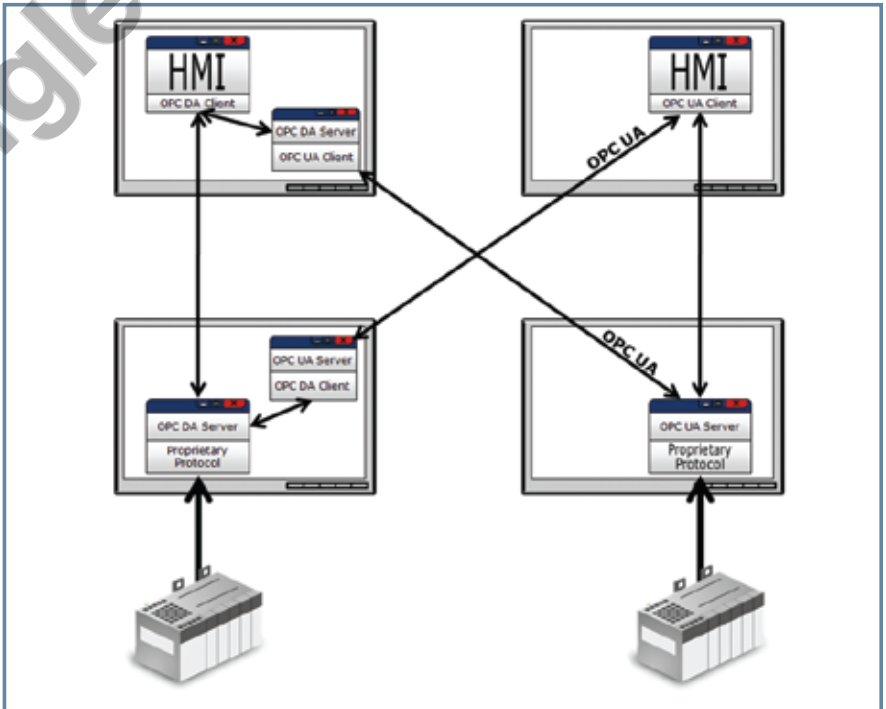

Figure 2 | With the unified data model offered by OPC UA, users can obtain the information they need by pointing at a single OPC item.

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of applications to benefit from the newly available data, as shown in Figure 3. For instance, computer maintenance management systems or enterprise asset management systems such as Maximo, Indus, IFS, and Ivara will be able to obtain equipment condition data so that they can implement a conditions-based maintenance program. Enterprise resource planning applications such as SAP, Oracle, PeopleSoft, JD Edwards, and Baan will be able to obtain inventory information or even send production orders without any manual intervention.

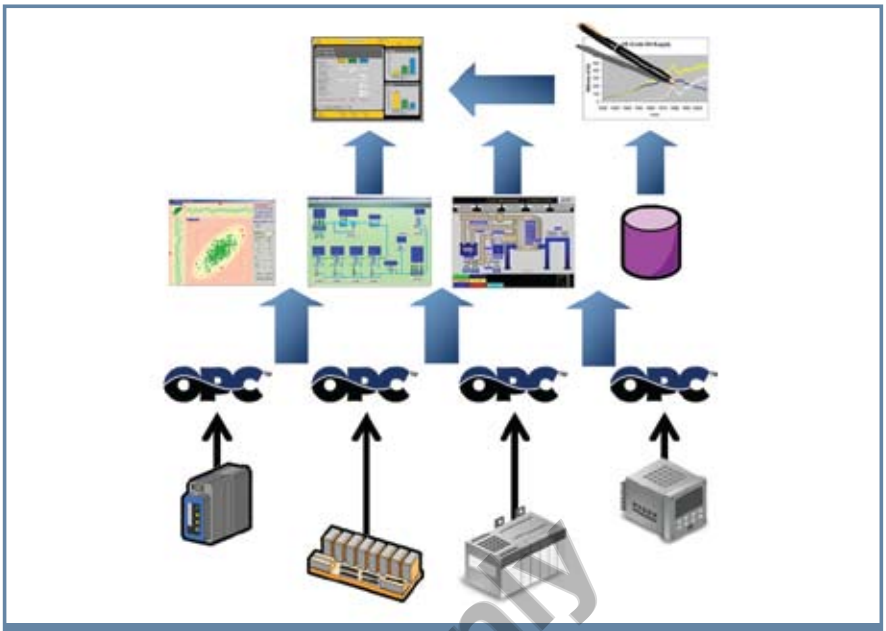

Figure 3 | A variety of industrial applications will benefit from data made available through OPC UA.

Security: The new challenge for automation

OPC UA makes it relatively easy for a multitude of applications to connect with each other. So the new challenge for automation personnel will be to secure their systems from unwanted connections. Web services will make it easy to cross firewalls and networks. Unwanted connections from people and applications will become far more common. However, unlike IT systems, automation systems are responsible for production and safety. Therefore, security will quickly rise to the forefront. Automation personnel will have to learn how to secure their systems in a way that still enables them to provide access to those who need it.

It remains to be seen how vendors will enable their applications with the three pillars of secure connectivity: authentication, authorization, and encryption. Various products that are already in the planning stages still do not include the necessary facilities for proper security. These applications use "security by obscurity," which essentially relies on a hacker's inability to understand how a system works to make it behave inappropriately. Both process and attitudes toward security will have to change.

Unifying the promise

OPC UA unifies the existing OPC specifications. It enables plants to replace the existing reliance on DCOM with Web services. It also introduces the concept of objects, which enables workers in a range of roles at the plant to access the same data in different ways. This enables them to produce a variety of reports and analytical calculations without having to cobble together data from many different sources.

The challenge for companies implementing OPC UA is to ensure their data is secure from unauthorized access. However, given all the promise that OPC UA holds, most industries will experience a sharp increase in OPC's penetration of their plants. IES

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For the scoop on how OPC UA and other M2M communication standards are helping improve machine interoperability and performance, check out the new *Industrial Embedded Systems* HyperMag coming in May. Visit www.industrial-embedded.com/hypermag.

Randy Kondor *is a computer engineer and the president of the OPC Training Institute, the world's largest OPC training company. Since 1996, Randy has been involved within the OPC industry and is a strong supporter of the OPC Foundation. He continues to dedicate himself to spreading the OPC Foundation's message about system interoperability and intervendor cooperation. Randy has a B.Sc. in Computer Engineering from the University of Alberta.*

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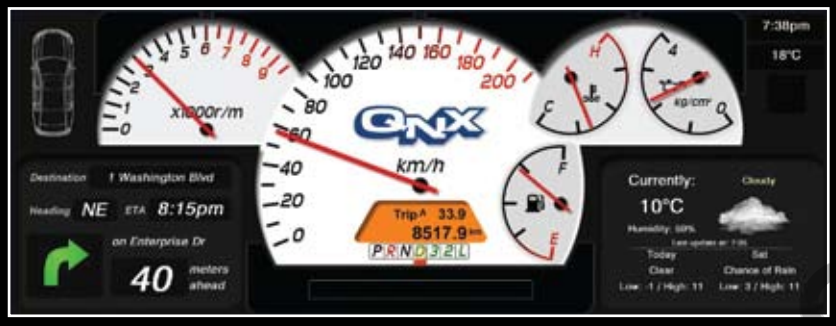
Applying modern UI technology to safety-critical systems

By Bill Graham



The User Interface (UI) can make all the difference between a product that works and a product that doesn't – and the results of not working can be disastrous. More robust, better tested, and more uniform interfaces are needed. One way to help achieve UI reliability is to eliminate the error-prone process of translating UIs designed with high-level tools into conventional graphics technology. Rather than use two or more technologies to design, prototype, and deploy UIs, teams can work with one common technology: Adobe Flash.

Between 1985 and 1987, three people died and three others fell seriously ill from radiation overdoses caused by user error and software malfunction in a radiation therapy machine, the Therac-25. An oft-quoted example of poor all-round design, the Therac-25 incident also highlights how the UI plays a major role in the success or failure of safety-critical systems.

For example, if a serious error occurred, the machine's UI would display "MALFUNCTION," followed by a numeric code from 1 to 64. Neither the UI, the device, nor the user manual explained what the various codes indicated. Moreover, the operator could override an error condition by simply pressing "P" on the keyboard. By allowing operators to bypass critical warnings, the UI contributed to the radiation overdoses. It also required tedious, repetitive user entries and contained bugs that led to erroneous entries[1].

Discussions of safety-critical design often focus on hard real-time control software. But, as the Therac-25 story demonstrates, the operator and the UI contribute just as much to system safety. Paradoxically, a technology that can help developers build better safety-critical UIs comes not from the world of real-time embedded systems, but from the world of consumer-grade computers and mobile devices.

Adobe Flash started life on the desktop and the Internet. Originally a Web animation technology, it has grown into a compelling tool for designing and implementing UIs such as the QNX-based digital instrument cluster for in-vehicle electronics (pictured on this page). Moreover, developers can use Adobe Flash Lite, which has been optimized for resource-constrained environments, to implement Flash-based UIs in their embedded systems. Already, manufacturers have deployed Adobe Flash Lite in more than 800 million devices.

A strong candidate

Adobe Flash offers many benefits: It is platform independent (that is, it runs the same across many Operating Systems or OSs), it supports fast prototyping and iterative UI development, and it has become the *lingua franca* of UI and graphics designers. These qualities make Flash a strong candidate for safety-critical UIs. To understand this point, consider some of the UI design guidelines published by the FDA[2]:

- Keep the UI consistent with user expectations. Consider the user's experience with similar devices and well-established conventions.
- Keep the display well-organized and uncluttered.
- Ensure that the user can see and hear signals. Consider the ambient lighting and noise.
- Keep labels, displays, controls, and acronyms consistent with the user manual and established conventions (for instance, PWR for Power).
- Arrange controls to prevent inadvertent activation.
- Use color and shape coding to convey information quickly, but ensure the coding follows universal conventions (for instance, most systems use red to indicate errors, so don't display alarms in blue).
- Provide feedback to user input.
- Correctly indicate resets, failures, or default values.
- Relieve the operator of complex processes or mental calculations.
- Don't use software when a simple hardware solution would suffice.
- Consider using dedicated displays to present critical information; don't display other data in these areas.

Adobe Flash addresses many of these requirements. For instance, consider the need to build a UI consistent with user expectations and well-established conventions. Flash-based UIs are, by nature, consistent across platforms, even when scaled to different screen sizes. Moreover, Flash allows developers to create highly interactive UIs that use the same familiar UI conventions found in consumer software applications for desktop environments.

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Consider also the need to create an uncluttered, understandable, easy-to-use UI. This goal is rarely achieved on the first try; the UI design typically must go through multiple iterations before it becomes sufficiently intuitive and understandable for operators. The need, then, is for a tool that excels at fast prototyping. Adobe Flash integrates with the most popular graphics design software packages used today, for instance, Adobe Photoshop or Adobe Illustrator, which are typically used to create graphical elements of UIs; it also adds animation and visual programming via ActionScript to provide a full-blown UI development environment. All this makes Flash a superior prototyping platform and helps teams iterate quickly through multiple revisions of the UI.

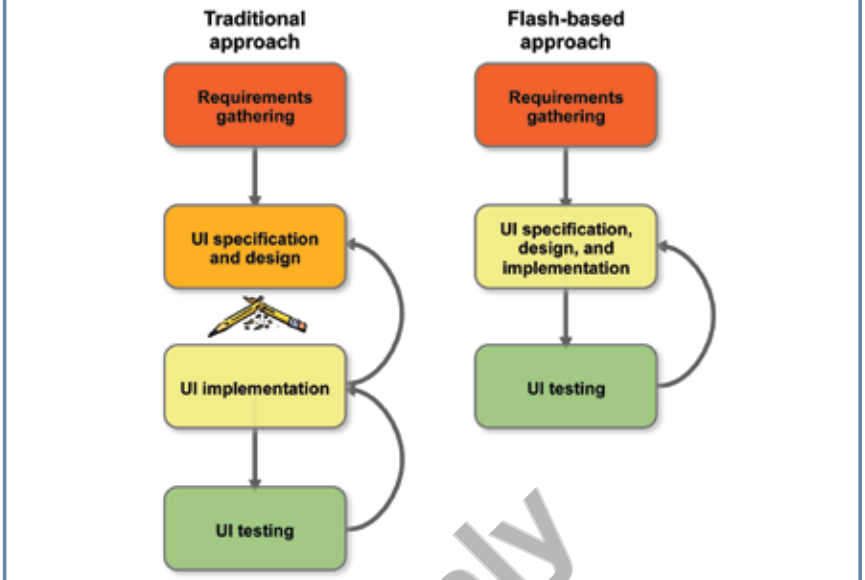
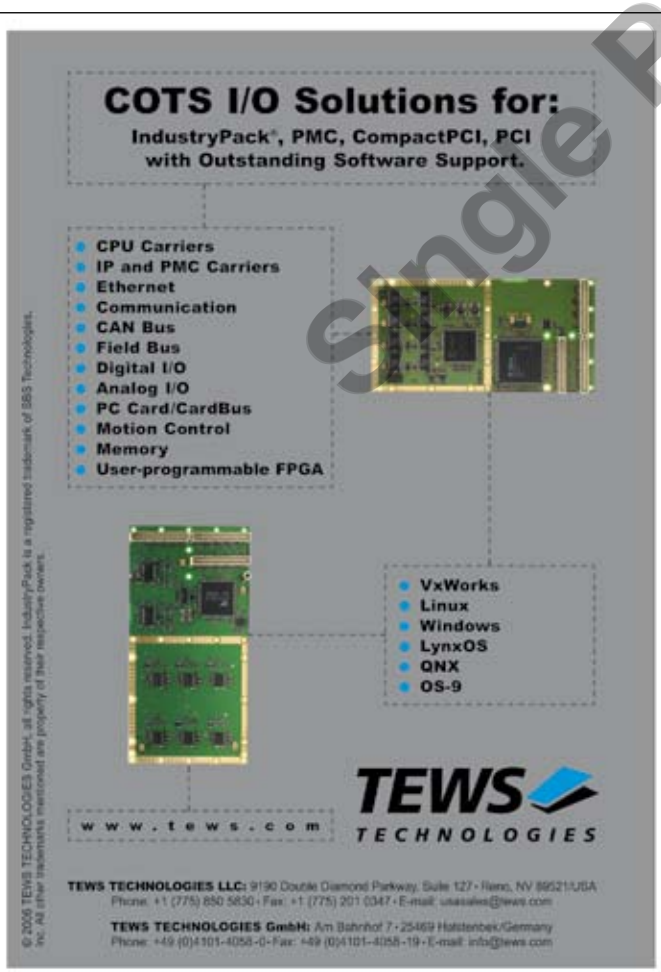


Figure 1 | Compared to traditional approaches, Flash offers a faster transition from design to deployment.

Smoother transition

The prototyping and evaluation phase, where the design team tests the UI design on real operators, constitutes a critical step in designing safe systems. Because Flash provides consistency between platforms, it allows developers to perform UI testing on a desktop system or reference platform well before the target hardware is available. UI testing can proceed while other software and hardware components are still in development.



Translating the finalized UI design to the operational device constitutes another key step. Traditionally, development teams would take the final output from the UI designer and translate it into conventional graphics technology, typically a collection of widgets, 2D libraries, or 3D graphics implemented in C. But now, teams can eliminate this time-consuming and error-prone step not only in function, but also in design, intuitiveness, and intent by building the UI with high-level Flash tools and then deploying that UI directly on an embedded Flash player. Eliminating the translation from designer tools to developer tools improves productivity and enhances UI design and usability.

Figure 1 contains two flow charts, one depicting the traditional approach of translating UI prototypes into conventional graphics technology (widgets, 2D/3D libraries, and so on) and the other showing the faster transition from design to implementation in Flash.

Determinism and real-time behavior

By its very nature, Adobe Flash doesn't provide a deterministic or real-time programming environment. It uses an interpreted Javascript-based language, ActionScript, which runs in a virtual machine inside the Flash player. Nonetheless, system designers can still use Flash in safety-critical systems for several reasons:

- Adobe Flash Lite embedded players use less CPU and memory resources than their desktop equivalents and are specifically tuned for the Real-Time OS (RTOS) they run on.
- By following some simple design guidelines, system designers can limit the CPU and memory resources required for the Flash player. For instance, designers can minimize alpha blending and transparency, avoid overuse of gradients, and use the minimum acceptable frame rate for animations.
- Many embedded OSs, including the QNX Neutrino RTOS,

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Figure 2 | Using graphics layers, designers can combine Flash-based and real-time graphics on the same display.

provide CPU time partitioning, which allows the system designer to control and limit how much memory and CPU time the Flash player consumes. Conversely, partitioning can also ensure that the Flash player always has enough memory and CPU time to respond quickly to user input.

- Some RTOSs provide an easy-to-use communications interface from Flash ActionScript applications running within the Flash player (the interpretive, non-real-time environment) to RTOS threads and processes (the hard real-time environment). This interface gives system designers the flexibility to assign activities to the real-time processing layer as needed. Designers can relegate noncritical UI functions to ActionScript.
- Graphical layering technology allows developers to overlay multiple UI technologies on the same screen (shown in Figure 2). By using software blending or hardware layering support, system designers can seamlessly blend Flash-based graphics with real-time 2D or 3D rendering of time-critical data.

Guaranteed performance

Besides serving as an ideal UI designer's tool, Adobe Flash also offers flexible development and deployment technology for embedded systems. Its familiarity and support for widely accepted UI conventions make it well-suited for UIs in all sorts of devices. Its support for rapid prototyping and iterative design helps guarantee that the UI is sufficiently tested and easy to use.

Combining Flash with the preemptive scheduling and time partitioning of modern embedded OSs ensures timely response in safety-critical applications, while graphical layering allows developers to leverage 2D/3D real-time graphics technology for displaying critical information. IES

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Bill Graham *is a product marketing manager at QNX Software Systems, based in Ottawa, Ontario, Canada. He has more than 20 years of experience in the software industry, including work with embedded and real-time systems development, software development processes and techniques, UML modeling, and object-oriented design. He holds Bachelor's and Master's degrees in Electrical Engineering from Carleton University in Ottawa, Canada.*

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- Input power less than 74 W, max power 24 W
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ADN DIN Rail Mount

Emerson Network Power's range of DIN Rail Mount power supplies extends from 15-960 W. All models are designed for an industrial environment with no derating up to 60 °C.

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- The Three-Phase models (120-960 W) accept 380-480 Vac input. With 24 Vdc output the line is more than 90% efficient and meets EN 61000-3-2 power factor correction requirements.

FEATURES

- Available in AC-DC and DC-DC versions varying from single-phase to three-phase inputs
- Meets EN 60950, UL 60950, UL 60079-15, IEC 60079-15 (hazardous locations), UL 508, EN 61000-3-2 and Sag Immunity
- Adjustable voltage and power factor correction
- Highly efficient > 90% switching technology
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FEATURES

- Wide input range: 3.0-13.8 Vdc (4.5 Vdc minimum input for 20 A module)
- -40 °C to +85 °C operating ambient temperature range
- Enable pin, power good signal, differential remote sense, margin control
- 16.26 x 16.26 mm Land Grid Array package
- Low profile – 3.2 mm typical

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The LPS100-M Series features a universal 90-264 Vac input – enabling it to be used anywhere in the world – and has 150 W of power.

FEATURES

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- Isolated 12 V fan output with adjustable main output
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MTC600 Series

Emerson Network Power's MTC600 power module series provides a self-contained power solution for MicroTCA systems. The modules can support shelves, cubes and other system implementations, and are fully compliant with the PICMG MicroTCA.0 Revision 1.0 specification.

MTC600 power modules are available in DC-input or AC-input versions and implement all of the incoming power conversion, power management and power protection functionality necessary for a complete MicroTCA system comprising up to 12 AdvancedMCs, 2 MicroTCA Carrier Hubs and 2 Cooling Units. The AC modules support an input voltage of 90-264 Vac. The DC modules support an input voltage of 39-72 Vdc.

FEATURES

- Complete power supply, power management and power protection for MicroTCA systems
- Compact, high power density, single-width module, 12 HP high
- 600 W output power
- 16 output channels, each capable of delivering 12 V @ 7.6 A payload power and 3.3 V @ 150 mA management power
- Provides power for up to 12 AdvancedMCs, 2 MicroTCA Carrier Hubs and 2 Cooling Units
- Supports N+1 redundancy and hot-swap operation

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HE104+DX

The HE104+DX is a high-efficiency 108W DC-DC converter that can supply +3.3V, +5V, +12V, and -12V DC outputs. The HE104+DX is designed for low-noise embedded computer systems, has a wide input range of 6V to 40V DC, and is ideal for battery or unregulated input applications. The HE104+DX is specifically designed for vehicular applications and has heavy-duty transient suppressors (9,000W on both main and secondary inputs) that clamp the input voltage to safe levels, while maintaining normal power supply operation. The HE104+DX is a MOSFET-based design that provides outstanding line and load regulation with efficiencies up to 90 percent. Organic Semiconductor Capacitors provide filtering that reduces ripple noises below 20mV. The low-noise design makes the HE104+DX ideal for use aboard aircraft or military applications or wherever EMI or RFI must be minimized.

FEATURES

- 108W DC-DC converter
- +3.3V, +5V, +12V, and -12V DC output
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- Extended temperature: -40°C to +85°C
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- High efficiency up to 90 percent
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- Low output ripple
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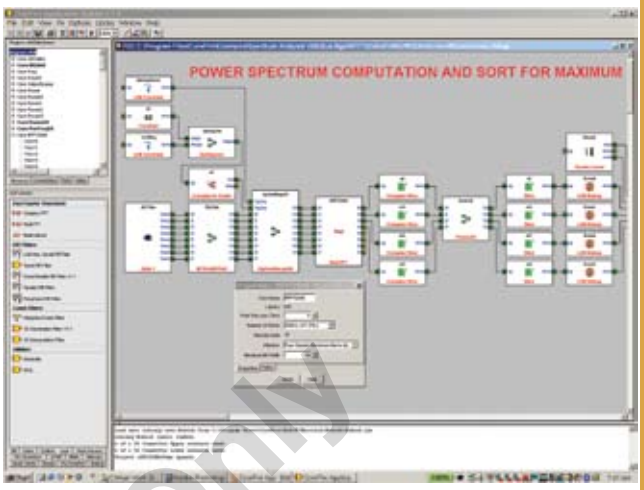

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Four Channel Clock Synchronization Board

The Four Channel Clock Synchronization Board distributes a common clock and synchronized control signal triggers to multiple cards in the system. This 6U VME64x/VXS board provides four high-speed, ultra-low jitter, ultra-low skew differential bulkhead-mounted clock outputs, two ultra-low skew differential vertical SMA onboard clock outputs, and four ultra-low skew and clock synchronized single-ended bulkhead-mounted control signal triggers.

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The four control trigger outputs can originate from a high-precision external source via front panel SMA, from a manual push button on the front panel, or from software via an optional backplane P2 connector serial port. These trigger outputs are synchronized to the distributed clock to provide precise output timing relationships.

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FEATURES

- Four synchronized differential front panel clock outputs up to 3 GHz with typical skew of 5 ps
- Ultra-low clock jitter and phase noise – 275 Fs with 1,280 MHz PLL and external 10 MHz reference
- Onboard PLL's manufacturing options provide fixed frequencies of 700 MHz to 3 GHz, locked to internal or external reference
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- Source trigger from front panel SMA, push button, or optional P2 serial port
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- Compatible with standard VME64x and VXS 6U backplanes
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WILDSTAR 4 for VXS

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WILDSTAR 5 for PCI Express

Annapolis Micro Systems, Inc. is a world leader in high-performance COTS FPGA-based processing for radar, sonar, SIGINT, ELINT, Digital Signal Processing, FFTs, communications, software radio, encryption, image processing, prototyping, text processing, and other processing-intensive applications.

Twelfth-generation WILDSTAR 5 for PCI Express uses Xilinx Virtex-5 FPGAs for state-of-the-art performance. It accepts one or two I/O mezzanine cards, including Single 1.5 GHz 8-bit ADC, Quad 250 MHz 12-bit ADC, Single 2.5 GHz 8-bit ADC, Quad 130 MHz 16-bit ADC, Dual 2.3/1.5 GSps 12-bit DAC, Quad 600 MSps 16-bit DAC, Universal 3 Gbit Serial I/O (RocketIO, 10 Gb Ethernet, InfiniBand), and Tri XFP (10G Fibre Channel, 10 Gb Ethernet, OC-192). Our boards work on a number of operating systems, including Windows, Linux, Solaris, IRIX, ALTIX, and VxWorks. We support our board products with a standardized set of drivers, APIs, and VHDL simulation models.

Develop your application very quickly with our CoreFire™ FPGA Application Builder, which transforms the FPGA development process, making it possible for theoreticians to easily build and test their algorithms on the real hardware that will be used in the field. CoreFire, based on data flow, automatically generates distributed control fabric between cores.

Our extensive IP and board support libraries contain more than 1,000 cores, including floating point and the world's fastest FFT. CoreFire uses a graphical user interface for design entry, supports hardware-in-the-loop debugging, and provides proven, reusable, high-performance IP modules.

WILDSTAR 5 for PCI Express, with its associated I/O cards, provides extremely high overall throughput and processing performance. The combination of our COTS hardware and CoreFire allows our customers to make massive improvements in processing speed, while achieving significant savings in size, weight, power, person-hours, dollars, and calendar time to deployment.

Annapolis is famous for the high quality of our products and for our unparalleled dedication to ensuring that the customer's applications succeed.

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FEATURES

- Up to three Xilinx Virtex-5 FPGA I/O processing elements – LX110T, LX220T, LX330T, or FXT
- Up to 7 GB DDR2 DRAM in 12 memory banks per WILDSTAR 5 for PCI Express board or up to 2 GB DDR2 DRAM in two memory banks and up to 40 MB DDRII, QDRII SRAM, or up to 1.4 GB RLDRAM
- Programmable Flash for each FPGA to store FPGA image
- 8x PCI Express bus. High-speed DMA multichannel PCI controller
- Supports PCI Express Standard External Power Connector
- Available in commercial or industrial temperature ranges
- Full CoreFire Board Support Package for fast, easy application development
- VHDL model, including source code for hardware interfaces and ChipScope access
- We offer training and exceptional special application development support, as well as more conventional support
- Includes one-year hardware warranty, software updates, and customer support
- Proactive thermal management system – board-level current measurement and FPGA temperature monitor, accessible through Host API
- Save time and effort. Reduce risk with COTS boards and software
- Achieve world-class performance; WILD solutions outperform the competition

For more information, contact: wfinfo@annapmicro.com **RSC# 36017 @ www.industrial-embedded.com/rsc**

Jacyl Technology
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Mission Workstation

The Mission Workstation is a multi-computer ruggedized workstation for applications that demand the best. The Mission Workstation features 4 completely independent computer systems housed in a single 19" 6U rack mount enclosure. The Mission Workstation can be ordered with a standard set of options for each computer, or each individual computer within the Mission Workstation can be custom configured from our factory for CPU processing capability, video processing capability, I/O capabilities, and/or OS configurations to meet your system requirements. The Mission Workstation can also be factory configured as a single cluster computer, harnessing the full potential of up to 16, 3 GHz Intel processors and 32 GB of DDR2 RAM. This parallel processing capability is available to meet the most demanding applications.

The Mission Workstation has been specially designed to be a ruggedized multi-computer system with unique features such as custom air filters located on all air cooling inlets, specially designed internal dual ball bearing fan cooling system for each individual computer, steel reinforced internal structure, anodized aluminum enclosure, removable ruggedized hard-drive caddies, full access to all CPU, video, and I/O ports from the front of the unit, and reinforced internal cable routing.

The Mission Workstation is designed to be utilized in the most demanding applications. Every production Mission Workstation is tested to a 3G NAVMAT vibration profile with the unit fully powered and subjected to full temperature range Environmental Stress Screening (ESS) with the unit fully powered. Other production testing is performed on each Mission Workstation such as 100% loaded CPU duration testing, 100% video processor duration test, performance verification testing, and burn-in testing all to ensure that the Mission Workstation is the most ruggedized and reliable multi-computer workstation available.

Jacyl Technology is the OEM of the Mission Workstation and provides an off-the-shelf or custom configuration of the Mission Workstation to meet the requirements of your system design.

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FEATURES

- All CPU, video, and I/O connectors are located on the front of the unit for convenient access
- All air cooling intakes incorporate a ruggedized air/EMI filter system
- Every system is production tested to a fully powered 3G NAVMAT vibration test and Environmental Stress Screening (ESS) test
- Can be factory configured to be powered from a DC or AC input source
- All hard drives are removable and are enclosed within ruggedized caddies
- Each Mission Workstation is functionally tested from -10 °C to +60 °C
- Each computer can be independently configured with a Core 2 Duo or Core 2 Quad Intel Processor and processor clock speeds up to 3 GHz
- Each individual computer has 2 PCI, 1 PCI x6 or 2 PCI x8, 2 Gb Ethernet, 4 SATA, up to 2 ESATA, up to 12 USB 2.0 ports and up to 32 GB RAM
- Each of the 4 individual computers supports 32- or 64-bit operating system configurations
- Can be factory configured as 4 individual computer systems or 1 cluster/parallel computer
- When factory configured as a cluster computer, the processing power would include 16, 3 GHz processors, 32 GB RAM, and 5.7 TB HDD space
- Each individual computer supports SATA II 300 (dependent upon CPU selection) and RAID 0, 1, 5, 10 controller implementations

For more information, contact: sales@jacyl.com

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SENSORAY

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SENSORAY | embedded electronics

Model 2426 | Modular Industrial I/O via Ethernet

Model 2426 is a versatile and compact multifunction I/O board that concurrently serves up to four Ethernet clients.

It features eight optically isolated digital inputs, 16 digital outputs, six 12-bit analog inputs, one 12-bit analog output, an RS-422/485 serial port and a high-speed 32-bit encoder interface that accepts both quadrature and single-phase clocks. All I/O is accessible via Telnet and HTTP. It is powered from a single 24VDC supply.

FEATURES

- Concurrently serves up to four Ethernet clients
- Eight optically isolated digital inputs
- 16 digital outputs
- Six 12-bit analog inputs
- 12-bit analog output
- RS-422/485 serial port
- High-speed 32-bit encoder interface that accepts both quadrature and single-phase clocks

For more information, contact: info@sensoray.com **RSC# 36513 @ www.industrial-embedded.com/rsc**

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American Portwell Technology, Inc.

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Portwell

PEB-2738

Portwell's PEB-2738 utilizes the Intel ECX form factor and supports the latest options of the Intel Atom processor Z5xx series and the Intel System Controller Hub US15W, including industrial temperature range and larger footprint version with 1.0 mm ball pitch. The power-optimized micro-architecture of the new Intel Atom platform benefits a range of low power, wide temperature, and fanless devices in applications such as in-vehicle infotainment, medical, military, and industrial automation and control. The PEB-2738 is specifically designed to operate at a very low power consumption of less than 10 Watts at full loading. It supports dual independent display by LVDS and SDVO daughtercard (DVI/VGA/LVDS, project-based).

FEATURES

- Intel Atom processor Z5xx series and the Intel System Controller Hub US15W, featuring industrial temperature range and larger footprint version with 1.0 mm ball pitch
- One 200-pin SODIMM supports DDR2 SDRAM up to 2GB
- One Type II CompactFlash and one IDE connector
- Dual independent display: SDVO and 24-bit LVDS; multi-stream audio and CH5.1 supported
- Trusted Platform Module (TPM) and USB-Disk Module (UDM) could be added onboard
- Expansion: PCIe x1 golden finger and I/O connector with SDVO/USB/PCIe x1 signal

For more information, contact: info@portwell.com **RSC# 41621 @ www.industrial-embedded.com/rsc**

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XG-5000K

The XG-5000K, the 5 million gate PC/104-*Plus* FPGA board
Centered around a 5 million gate Spartan-3 FPGA, the XG-5000K is the ultimate PC/104-*Plus* FPGA board that is ready to meet the most demanding of system designs. The board features a 5 million gate Spartan-3 FPGA, 256 MB of onboard Micron SRAM, 32 MB of onboard Intel flash, 264 user-programmable I/O, Type 1 CompactFlash connector, a secondary 500K gate Spartan-3 FPGA, 10/100BASE-T Ethernet interface, two RS-232 interfaces, PC/104 connector, PC/104-*Plus* connector, 0-25 MHz programmable DDS master clock source, 8 MB of secondary DataFlash, and a 25 MHz initial master clock.

The XG-5000K has the advanced feature of allowing the user to remotely reconfigure the entire board through the onboard JTAG connector, the PC/104 connector, the PC/104-*Plus* connector, 10/100BASE-T Ethernet interface, or any external interface connected to the XG-5000K, which has been developed with Xilinx's advanced design revisioning technology. This allows the XG-5000K to retain onboard as many as 16 partial or up to 4 complete design revisions for the 5 million gate Spartan-3 FPGA. Any one of these design revisions can be remotely programmed into the 5 million gate Spartan-3 FPGA, or the XG-5000K can be programmed to reconfigure itself based upon external or internal events.

The XG-5000K also incorporates a secondary 500K gate Spartan-3 FPGA. This second FPGA is initially configured to control remote reprogramming and control of the design revisioning features of the XG-5000K. But the secondary Spartan-3 FPGA can be reconfigured by the user to meet the requirements of a particular system design.

The XG-5000K can be powered from the PC/104 bus or can be powered from a single 5 VDC external source allowing the board to be utilized as a stacked module in PC/104 applications or as a stand-alone product design platform. This allows the board to be ideal in embedded PC/104 applications or to be utilized in development platforms, design prototypes, or production products.

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FEATURES

- 5 million gate Xilinx Spartan-3 FPGA on a PC/104-*Plus* platform
- Onboard 256 MB of Micron SRAM and 32 MB of Intel flash
- Four 66-pin VHDC connector banks providing a total of 264 user-programmable I/O
- CompactFlash Type 1 connector
- A secondary 400K gate Spartan-3 FPGA for remote reconfiguration and design revisioning of the XG-5000K or custom user configuration
- 10/100BASE-T Ethernet interface and two RS-232 interfaces
- Can be used in a PC/104 stack or as a stand-alone product design platform
- 0-25 MHz user-programmable DDS FPGA master clock source, along with a fixed 25 MHz FPGA master clock source
- Incorporates Xilinx's design revisioning technology and can retain onboard as many as 16 partial or up to 4 complete design BIT files
- Can be reconfigured through the configuration PROMs, JTAG, 10/100BASE-T Ethernet, PC/104, PC/104-*Plus* connectors, or the user I/O
- Available in industrial temperature range
- Can be powered from the PC/104 connector or an external 5 VDC source

For more information, contact: sales@jacyl.com

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WinSystems, Inc.
715 Stadium Drive • Arlington, TX 76011
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EPX-855-G Fanless 1GHz SBC

The EPX-855-G-1G-0 is a highly integrated, low-cost Single Board Computer designed for rugged, performance-driven applications. It operates over a temperature range of -40°C to +70°C without a fan and is designed for applications including industrial automation, security, medical/diagnostic equipment, MIL/COTS, test and measurement, and transportation. WinSystems uses chipsets from Intel's long life embedded road map to ensure longevity of the core technology.

The EPX-855-G includes support for both wired and wireless Ethernet (with remote boot capability), simultaneous support of both SVGA and LVDS flat panel video, four USB 2.0 ports, four serial COM ports, AC'97 audio, PS/2 keyboard, LPT, and 24 lines of digital I/O. It supports up to 1GB of industry-standard PC2700 SDRAM, up to 8GB of CompactFlash, plus support for hard and floppy disk drives. PC/104 and PC/104-*Plus* expansion is supported for additional special I/O requirements.

It also supports advanced features such as custom splash screen, APM 1.2 and ACPI 1.0b power management modes, PXE boot, and multi-language support. The BIOS supports legacy operation of a USB keyboard and mouse, as well as booting from a USB floppy disk, USB keys, and other USB-connected mass storage devices.

The board supports Windows® XP embedded, Linux, and other x86-compatible RTOSs. The EPX-855-G requires only +5V and typically draws 2.1A with 1GB of DDR SDRAM installed. A 1.8GHz Pentium® M version is available. These features are also available in our EBC-855 EBX-compliant board.

FEATURES

- Intel® 1GHz CPU (fanless); higher-performance 1.8GHz Pentium® M version is available
- Intel® Extreme Graphics 2 technology supports CRT and LVDS flat panels simultaneously
- Custom splash screen on startup
- Two Intel Ethernet controllers: one Gigabit and one 10/100 Mbps
- 802.11a/b/g wireless supported
- Four serial COM ports, four USB 2.0 ports, and 24 bi-directional TTL digital I/O lines
- Bi-directional LPT port, AT keyboard, and FDC controller
- PC/104 and PC/104-*Plus* expansion
- 4.5" x 6.5" (115mm x 165mm) EPIC-compliant SBC
- Also available in 5.75" x 8.0" EBX-compliant SBC
- Long-term product availability
- Quick Start Kits for software development

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For more information, contact: Info@WinSystems.com **RSC# 41297 @ www.industrial-embedded.com/rsc**

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www.winsystems.com

PCM-MIO Multifunction A/D

The PCM-MIO is a versatile, PC/104-based analog input, analog output, and digital I/O board designed to meet customer demands for high-accuracy and high-channel count analog and digital I/O. The board is based on Linear Technologies' precision converters and voltage references, which require no external calibration.

The board will support up to 16 single-ended input channels, 8 differential input channels, or various combinations of both. The software programmable input ranges are ±5V, ±10V, 0-5V, and 0-10V. The input channels are voltage protected to ±25V and can work directly with industry-standard signal conditioning modules.

There are eight 12-bit Digital-to-Analog (D/A) converters with individual software programmable voltage ranges of ±5V, ±10V, 0-5V, and 0-10V. The output channels can be updated and cleared individually or simultaneously. They also work with industry-standard signal conditioning modules.

A total of 48 onboard bi-directional TTL-compatible digital I/O lines can be software configured as Input, Output, or Output with Readback. Twenty-four can generate interrupts if the board senses a change of state. Each output can sink 12mA and will interface directly with opto-isolated modules.

The PCM-MIO operates over the industrial temperature range of -40°C to +85°C. Free software drivers are available for C, Windows®, and Linux.

WinSystems can depopulate this board to meet special OEM applications. For example, all the A/D channels or perhaps all the D/A channels could be removed. Please contact an applications engineer with your requirements.

FEATURES

- Analog and digital I/O on a PC/104 module
- 16-bit Analog-to-Digital (A/D) converter
- Conversion speed: 100K samples per second
- Two quad 12-bit Digital-to-Analog (D/A) converters
- Each individual channel is independently software programmable
- Low-noise onboard DC/DC converter
- No adjustment potentiometers or calibration needed
- 48 bi-directional TTL-compatible digital I/O lines with 24 capable of event sense interrupt generation
- Free software drivers in C, Windows®, and Linux
- +5V-only operation
- -40°C to +85°C temperature operation
- Special OEM configurations available for 16-bit D/A and other analog and digital I/O combinations

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For more information, contact: Info@WinSystems.com **RSC# 41298 @ www.industrial-embedded.com/rsc**

WinSystems, Inc.
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PPM-LX800 Extended Temperature PC/104-*Plus* SBC

The PPM-LX800-G is a highly integrated, PC/104-*Plus* Single Board Computer (SBC) designed for space-limited and low-power applications. It is a full-featured SBC that utilizes an AMD LX800 x86-compatible CPU.

Onboard I/O functions include analog CRT and digital flat panel video controller, Intel 82551ER 10/100 Ethernet, two USB 2.0 ports with overcurrent protection on each channel, and four COM channels. The PPM-LX800-G provides standard PC controllers for IDE hard disks, CompactFlash device, PS/2 mouse and keyboard controller, AC'97 audio, LPT, and PC/104-*Plus* expansion connectors all on a single 90mm x 96mm module.

There are 16 bits of TTL-compatible digital I/O with each line individually programmable for Input, Output, or Output with Readback operation. The major feature of the onboard digital I/O controller is its ability to monitor the 16 lines for either rising or falling digital edge transitions, latch them, and then interrupt the host processor notifying it that a change-of-input status has occurred.

The PPM-LX800-G has x86 PC software compatibility that assures a wide range of tools to aid in your application program development and checkout. It supports both Windows® XPe and Linux operating systems and other RTOSs. WinSystems provides free technical phone support to assist customers with system integration of our SBCs and I/O modules.

The SBC's low power dissipation permits fanless operation over a temperature range from -40°C to +85°C. The PPM-LX800-G is well suited for rugged applications requiring excellent processor performance in an embedded PC design.

FEATURES

- AMD LX800 CPU; x86-compatible
- Small size: 90mm x 96mm
- Video with CRT resolutions to 1920 x 1440 and panel resolutions to 1600 x 1200
- Custom splash screen on startup
- 10/100 Mbps Ethernet controller
- Two USB 2.0 ports with overcurrent protection
- Four COM channels with FIFO
- 16 digital I/O lines with event sense supported
- AC'97 audio, LPT, mouse, and keyboard controllers
- -40°C to +85°C operating temperature
- Long-term PC/104-*Plus* product availability

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For more information, contact: Info@WinSystems.com **RSC# 41296 @ www.industrial-embedded.com/rsc**

Tri-M Engineering

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VSX104+

The VSX104+ is a 300MHz PC/104-*Plus* CPU module with dual 10/100 LAN. Its 300MHz DM&P Vortex86SX System-on-Chip (SoC) is a fully static 32-bit x86 processor designed to work with embedded operating systems including Windows® CE, Linux, DOS, and most popular 32-bit RTOSs. Standard features of the VSX104+ include soldered 128MB DDR2 RAM, four COM ports, two USB 2.0, and two 10/100 LAN ports. An 8-bit GPIO port and redundancy port are also standard features. In addition to 2MB onboard SPI flash, the VSX104+ includes a Type I CompactFlash™ and microSD socket. System expansion is supported by the PC/104-*Plus* interface. The VSX104+ has an operating temperature of -40°C to +85°C. Single +5VDC power is supplied through the PC/104 bus or 2-position screw terminal, and total power consumption is a mere 2.5W.

FEATURES

- 300MHz Vortex86SX SoC
- 128MB soldered DDR2 RAM
- Integrated dual 10/100 LAN, 4x RS-232, 2x USB 2.0, 1x LPT, keyboard, mouse
- 2MB onboard SPI flash
- PC/104-*Plus* compliant
- Fanless operation
- 2.5W power consumption
- Type 1 CompactFlash™ and microSD sockets
- Extended temperature operation
- RoHS compliant

For more information, contact: info@tri-m.com **RSC# 41282 @ www.industrial-embedded.com/rsc**

Emerson Network Power

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EmersonNetworkPower.com/EmbeddedComputing

MATXM-C2-410-B MicroATX Industrial Motherboard

The MATXM-C2-410-B MicroATX industrial motherboard from Emerson Network Power is designed to ease deployment in a range of retail applications such as Point-Of-Sale (POS) terminals, interactive product displays and customer kiosks. It has a unique midplane that creates a level of modularity sufficient to allow cost-effective replacement during deployment. By routing all power and LCD display cabling through the midplane, the likelihood of cabling errors during maintenance is reduced.

Designed to support a wide range of POS peripherals, MATXM-C2-410-B has both 12 and 24 V PoweredUSB connections. These are suitable for powering devices like bar code scanners and POS printers without the expense of additional power supplies. This motherboard supports dual independent displays and has VGA/LVDS and HDMI interfaces for connection to the widest possible range of displays.

FEATURES

- 478-pin micro-FCPGA socket (socket P) for Intel® Core™2 Duo processor T9400 or Intel® Celeron® processor 575
- Unique midplane allowing easy, cost-effective maintenance
- PoweredUSB ports for connection to POS peripherals
- 512MB to 8GB DDR3
- LVDS or VGA primary display, HDMI secondary display
- Innovative power management features help to reduce energy consumption
- Energy saving features help to minimize noise during operation
- Utilizes Intel® vPro™ technology to remotely power on/off system, helping reduce carbon emissions

For more information, contact: EmbeddedComputingSales@Emerson.com **RSC# 41607 @ www.industrial-embedded.com/rsc**

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SFPDP UNI6 I/O

Annapolis Micro Systems Inc.'s FPGA-based WILDSTAR family provides 24 SFPDP channels per VME slot.

The Annapolis SFPDP cards (UNI3 or UNI6) come with an easy-to-use Serial FPDP interface supporting up to 12 lanes of 2.5 Gb full duplex data. Three frame types are supported: Normal Data Fiber Frame, Sync Without Data Fiber Frame, and Sync with Data Fiber Frame in Point-to-Point Mode.

The card has three individually configurable, industry-standard 4X connectors, providing four lanes per connector, with dedicated signal conditioners to ensure clean communication. It supports up to 7.5 GB full duplex per I/O card and a wide variety of readily available copper and fiber cables.

Up to two serial I/O cards and two LVDS I/O cards can reside on each WILDSTAR 4 or WILDSTAR 5 VME/VXS main board, with half that number for the PCI-X or PCIe. The SFPDP card (UNI6) supports RocketIO protocol at up to 75 Gb full duplex per I/O card, three ports of 10G full duplex InfiniBand per I/O card, or 10G full duplex Ethernet per I/O card.

No other FPGA board vendor can match the volume of data we can send straight into the heart of the processing elements and then straight back out again. An FPGA-based high-performance processing engine thrives on data streaming in and out at high rates of speed. The FPGAs should be part of a balanced and unified system architecture, providing maximum performance, with memory, processing power, and I/O speeds designed and integrated for performance, scalability, and growth.

Annapolis Micro Systems, Inc.'s WILDSTAR 4 (Xilinx Virtex-4 based) and WILDSTAR 5 (Xilinx Virtex-5 based) families of FPGA-based processing boards also support an extensive set of extremely high-quality A/D and D/A boards.

Annapolis Micro Systems, Inc. is a world leader in high-performance COTS FPGA-based processing for radar, sonar, SIGINT, ELINT, Digital Signal Processing, FFTs, communications, software radio, encryption, image processing, prototyping, text processing, and other processing-intensive applications.

Annapolis is famous for the high quality of our products and for our unparalleled dedication to ensuring that the customer's applications succeed.

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FEATURES

- Three individually configurable 4X connectors – four lanes per connector
- Up to four 2.5 Gb full duplex Serial FPDP ports per connector
- Up to 25 Gb full duplex RocketIO per connector
- Up to 10 Gb full duplex InfiniBand per connector
- Up to 10 Gb full duplex Ethernet per connector
- Optional onboard oscillators for other line rates like Fibre Channel
- I/O card plugs onto WILDSTAR 4 or 5 VME/VXS/IBM Blade Chassis/PCI-X/PCI Express main board
- JTAG, ChipScope, and Serial Port access
- Proactive thermal management system. Available in both commercial and industrial temperature grades
- Includes one-year hardware warranty, software updates, and customer support
- We offer training and exceptional special application development support, as well as more conventional customer support
- Full CoreFire Board Support Package for fast, easy application development
- VHDL model, including source code for hardware interfaces

For more information, contact: wfinfo@annapmicro.com **RSC# 35968 @ www.industrial-embedded.com/rsc**

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Tri XFP I/O Card

Annapolis Micro Systems, Inc. is a world leader in high-performance COTS FPGA-based processing for radar, sonar, SIGINT, ELINT, Digital Signal Processing, FFTs, communications, software radio, encryption, image processing, prototyping, text processing, and other processing-intensive applications.

The Annapolis Tri XFP I/O Card, which works with the WILDSTAR 4/5 Family Architecture, has three 10 Gb individually configured XFP connectors, each with its own XAUI to XFI converter. Industry-standard pluggable fiber optic transceivers can be purchased from Annapolis or from other vendors. The Tri XFP provides up to 30 Gb full duplex I/O directly between the outside world and the RocketIO pins on the Xilinx Virtex-II Pro or Virtex-4 I/O FPGA on the WILDSTAR 4 main board. No other vendor provides that volume of data straight into the heart of the processing elements and then back out again.

Two I/O cards can reside on each WILDSTAR 4 or WILDSTAR 5 VXS or PCI-X/PCI Express board, with up to 30 million user reprogrammable gates.

The Tri XFP card will support 10 Gb Ethernet, 10 Gb Fibre Channel, and OC-192. Although the protocols will be provided as black box solutions with few modifications by users allowed, more adventurous users who choose to develop their own communications protocols from the basics already have access to all the board resources through VHDL source for the interfaces to SRAM, signal conditioners, LAD bus, I/O bus, and PPC Flash. CoreFire™ users will have the usual CoreFire Board Support Package.

The Tri XFP is the first of many I/O cards Annapolis will be releasing for its new WILDSTAR 4/5 Architecture Family, which uses Xilinx Virtex-4 and Virtex-5 FPGAs for processing elements. WILDSTAR 4 is the tenth generation of Xilinx FPGA processing-based COTS boards from Annapolis.

Annapolis is famous for the high quality of our products and for our unparalleled dedication to ensuring that the customer's applications succeed. We offer training and exceptional special application development support, as well as more conventional customer support.

FEATURES

- Up to 10 Gb Full Duplex Ethernet per connector
- Up to 10 Gb Fibre Channel
- OC-192
- Three 10 Gb XFP connectors
- Accepts industry-standard pluggable transceivers
- Available in both commercial and industrial temperature grades
- Includes one-year hardware warranty, software updates, and customer support
- One or two I/O cards fit on a single WILDSTAR 4/5 processing board
- New I/O form factor for improved thermal performance
- First of many WILDSTAR 4/5 Family I/O cards, including superior performance A/D, D/A, and additional high-speed communication cards
- Save time and effort. Reduce risk with COTS boards and software
- Achieve world-class performance; WILD solutions outperform the competition

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For more information, contact: wfinfo@annapmicro.com

RSC# 35857 @ www.industrial-embedded.com/rsc

HMS Industrial Networks

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Anybus CompactCom

The Anybus CompactCom family of interchangeable communication modules uses a common host interface regardless of which network is required. The CompactCom functions as a network coprocessor and is based on HMS' powerful NP30 microcontroller. The compact housing is robust and specially designed for industrial requirements. CompactCom can be implemented in a wide range of products, such as HMIs, drives, robot controllers, weigh scales, instrumentation, and more. The CompactCom supports DeviceNet, PROFIBUS, CC-Link, CANopen, Modbus, EtherNet/IP, PROFINET, Modbus TCP, EtherCAT, and additionally supports physical layer interfaces RS-232/422/485, USB, and Bluetooth. You could realize savings of up to 70% in your development costs and drastically reduce time-to-market.

FEATURES

- Anybus CompactCom starter kit including driver source code is available
- Support all networks with a single design effort
- No licenses, royalties, or stacks to purchase
- All modules are conformance tested and certified by the respective testing agency
- Local support from HMS global organization
- Low risk investment in proven technology

For more information, contact: us-sales@hms-networks.com **RSC# 36516 @ www.industrial-embedded.com/rsc**

Trident Space & Defense

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www.tridentsd.com

Triton Series Solid State Drives featuring Fast and Secure Erase

Secure your data with Trident's Triton Series of Solid State Drives featuring Fast and Secure Erase. Trident's Triton Series drives are purpose built for high-end industrial and rugged military applications. Our Triton Series drives incorporate proven non-volatile industrial grade SLC NAND Flash in a completely solid state design with no moving parts. Triton SSDs are offered in an industry-standard 2.5-inch form factor and are available with either an IDE/PATA or SATA interface. This makes them ideal as a direct drop-in replacement for conventional rotating hard disks that are prone to short production life and often fail in mobile computing and industrial environments where temperature fluctuations, shock, vibration, dust, moisture, and/or magnetic fields are present. For embedded computing, Trident offers its BGADrive, which is a small form factor SSD on a BGA module that can be mounted directly on a PCB. When it absolutely has to work, choose Trident for all your storage needs.

FEATURES

- Ruggedized Solid State Drive for military and high-end industrial applications
- Industrial grade SLC NAND Flash with operating temperature range from -40°C to +85°C
- Available with Fast and Secure Erase functionality for complete media declassification
- Tested to MIL-STD-810F: Shock 1,500G; Vibration 16.3G RMS
- Precision machined aluminum alloy case that is anodized inside and out for improved corrosion resistance and durability
- Available with custom features and in custom form factors

For more information, contact: sales@tridentsd.com **RSC# 41666 @ www.industrial-embedded.com/rsc**

Single Print Only

Annapolis Micro Systems
190 Admiral Cochrane Drive, Suite 130 • Annapolis, MD 21401
410-841-2514
www.annapmicro.com

2.0 GSps 10-bit A/D

The Annapolis Single Channel 2.0 GSps A/D I/O Card provides one 2.0 GHz A/D input with a resolution of 10 bits. The board has one e2v AT84AS004 that is fed by an onboard analog input circuit, which converts the single-ended 50 ohm SMA input into differential signals for the ADC. There is a universal single-ended 50 ohm SMA clock input and a high-precision trigger input allowing multiple A/D I/O cards to be synchronized together. Synchronization of A/D I/O cards can be facilitated by the Annapolis 4 or 8 Channel Clock Distribution Boards.

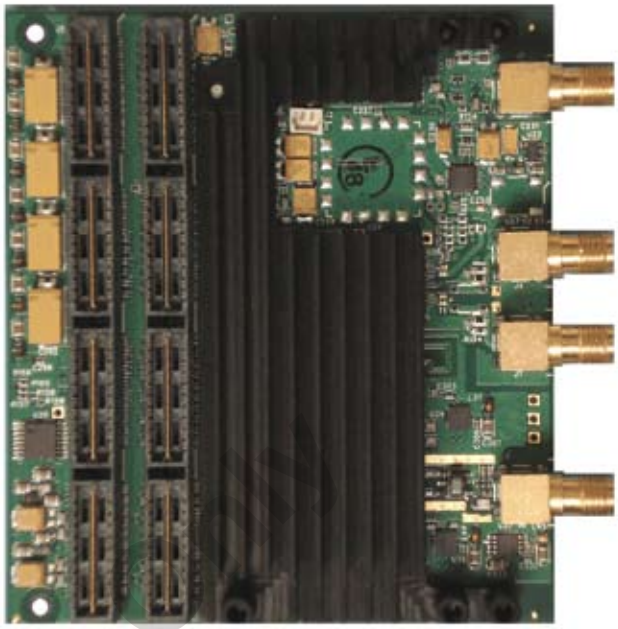
In concert with the WILDSTAR 4 or WILDSTAR 5 FPGA processing main boards, this mezzanine board supplies user-configurable real-time continuous sustained processing of the full data stream. Up to two A/D and up to two serial I/O cards can reside on each WILDSTAR 4 or WILDSTAR 5 VME/VXS or IBM Blade main board or up to one A/D and up to one serial I/O card on each PCI-X or PCI Express main board.

Our boards run on many different operating systems. We support our board products with a standardized set of drivers, APIs, and VHDL simulation models. VHDL source is provided for the interfaces to A/Ds, D/As, DRAM/SRAM, LAD bus, I/O bus, and PPC Flash. CoreFire™ users will have the usual CoreFire Board Support Package.

The combination of our COTS hardware and our CoreFire FPGA Application Development tool allows our customers to make massive improvements in processing speed, while achieving significant savings in size, weight, power, person-hours, dollars, and calendar time to deployment.

Annapolis Micro Systems, Inc. is a world leader in high-performance COTS FPGA-based processing for radar, sonar, SIGINT, ELINT, Digital Signal Processing, FFTs, communications, software radio, encryption, image processing, prototyping, text processing, and other processing-intensive applications.

Annapolis is famous for the high quality of our products and for our unparalleled dedication to ensuring that the customer's applications succeed.



FEATURES

- One e2v AT84AS004 (2.0 GHz, 10-bit) A/D
- Four SMA front panel connectors: one 50 ohm analog input, one single-ended 50 ohm clock input, or differential 1.65 V LVPECL clock input
- One high-precision trigger input with Fs precision. High-precision trigger input – 1.65 V LVPECL, 2.5 V LVPECL, 3.3 V LVPECL
- Analog input bandwidth is 100 KHz-3.0 GHz
- I/O card plugs onto WILDSTAR 4 or 5 VME/VXS/PCI-X/PCI Express/IBM Blade main boards
- JTAG, ChipScope, and Serial Port access
- Full CoreFire Board Support Package for fast, easy application development
- VHDL model, including source code for board-level interfaces
- Proactive thermal management system
- Includes one-year hardware warranty, software updates, and customer support
- We offer training and exceptional special application development support, as well as more conventional customer support
- Designed and manufactured in the USA

Single Print

For more information, contact: wfinfo@annapmicro.com **RSC# 36021 @ www.industrial-embedded.com/rsc**

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190 Admiral Cochrane Drive, Suite 130 • Annapolis, MD 21401
410-841-2514
www.annapmicro.com

Dual 4.0 GSps DAC

The Annapolis Micro Systems Dual Channel 4.0 GSps D/A I/O Card provides one or two 12-bit digital output streams at up to 4.0 GSps. The board has one or two Max 19693 for 4.0 GSps, Max 19692 for 2.3 GSps, or Max 5859 for 1.5 GSps.

The Dual Channel DAC board has five SMA front connectors: two single-ended DAC outputs, a high-precision trigger input with Fs precision, and a universal single- or double-ended 50 ohm clock input. It has excellent gain flatness in the first 3 Nyquist Zones, ultra-low skew and jitter saw based clock distributions, and main board PCLK sourcing capability.

In concert with the WILDSTAR 4 or WILDSTAR 5 FPGA processing main boards, this mezzanine board supplies user-configurable real-time A to D conversion and digital output. Up to two A/D or D/A and up to two serial I/O cards can reside on each WILDSTAR 4 or WILDSTAR 5 VME/VXS or IBM Blade main board, or up to one A/D or D/A and up to one serial I/O card on each PCI-X or PCI Express main board.

Our boards run on many different operating systems. We support our board products with a standardized set of drivers, APIs, and VHDL simulation models. VHDL source is provided for the interfaces to A/Ds, D/As, DRAM/SRAM, LAD bus, I/O bus, and PPC Flash. CoreFire™ users will have the usual CoreFire Board Support Package.

The combination of our COTS hardware and our CoreFire FPGA Application Development tool allows our customers to make massive improvements in processing speed, while achieving significant savings in size, weight, power, person-hours, dollars, and calendar time to deployment.

Annapolis Micro Systems, Inc. is a world leader in high-performance COTS FPGA-based processing for radar, sonar, SIGINT, ELINT, Digital Signal Processing, FFTs, communications, software radio, encryption, image processing, prototyping, text processing, and other processing-intensive applications.

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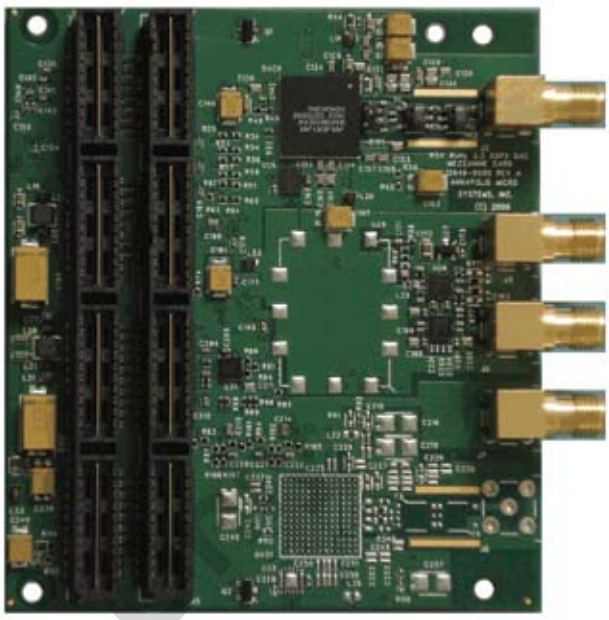

FEATURES

- One or two 12-bit Analog to Digital Converters: Max 19693 for 4.0 GSps, Max 19692 for 2.3 GSps, or Max 5859 for 1.5 GSps
- Five SMA front panel connectors: two single-ended DAC outputs, one high-precision trigger input with Fs precision
- One universal single- or double-ended 50 ohm clock input
- High-precision trigger input manufacturing options – 1.65 V LVPECL, 2.5 V LVPECL, 3.3 V LVPECL
- I/O card plugs onto WILDSTAR 4 or 5 VME/VXS/PCI-X/PCI Express/ IBM Blade main boards
- JTAG, ChipScope, and Serial Port access
- Full CoreFire Board Support Package for fast, easy application development
- VHDL model, including source code for board-level interfaces
- Proactive thermal management system
- Industrial temperature range
- Includes one-year hardware warranty, software updates, and customer support
- Designed and manufactured in the USA

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For more information, contact: wfinfo@annapmicro.com **RSC# 36023 @ www.industrial-embedded.com/rsc**

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www.annapmicro.com

WS4 Quad 250/400/500 MSps A/D

The Annapolis Quad Channel 250/400/500 MSps A/D I/O Card provides four A/D inputs with converter speeds of up to 250, 400, or 500 MHz and resolutions of 13, 14, or 12 bits, respectively. The board has four A/D converters from TI (ADS5444, ADS5474, or ADS5463) fed by onboard analog input circuits that convert the single-ended, 50 ohm SMA input into differential signals for the ADC.

There is an onboard ultra-low jitter and skew clock distribution circuit to allow all four channels on a single A/D I/O board to be synchronized together. There is also an external clock input and a trigger input allowing multiple A/D I/O cards to be synchronized together. Synchronization of A/D I/O cards can be facilitated by the Annapolis 4 or 8 Channel Clock Distribution Boards.

In concert with the WILDSTAR 4 or WILDSTAR 5 FPGA processing main boards, this mezzanine board supplies user-configurable real-time continuous sustained processing of the full data stream. Up to two A/D I/O cards can reside on each WILDSTAR 4 or WILDSTAR 5 VME/VXS or IBM Blade main board or reside on one A/D I/O card on each PCI-X or PCI Express main board.

Annapolis Micro Systems, Inc. is a world leader in high-performance COTS FPGA-based processing for radar, sonar, SIGINT, ELINT, Digital Signal Processing, FFTs, communications, software radio, encryption, image processing, prototyping, text processing, and other processing intensive applications.

Our boards run on many different operating systems. We support our board products with a standardized set of drivers, APIs, and VHDL simulation models. VHDL source is provided for the interfaces to A/Ds, D/As, DRAM/SRAM, LAD bus, I/O bus, and PPC Flash. CoreFire™ users will have the usual CoreFire Board Support Package.

The combination of our COTS hardware and our CoreFire FPGA Application Development tool allows our customers to make massive improvements in processing speed, while achieving significant savings in size, weight, power, person-hours, dollars, and calendar time to deployment.

FEATURES

- Four TI A/D converters of one of the speed and bit size types: ADS5444 250 MSps 13 bits, ADS5474 400 MSps 14 bits, ADS5463, 500 MSps 12 bits
- Analog input bandwidths of up to: 500 MHz for the 250 MSps A/D board, 1,400 MHz for the 400 MSps A/D board, 2,000 MHz for the 500 MSps A/D
- Six SMA front panel connectors: four 50 ohm analog inputs, one single-ended 50 ohm clock input, one trigger input
- Onboard ultra-low jitter and skew clock distribution circuit to allow synchronization of all four channels on a single I/O card
- I/O card plugs onto WILDSTAR 4 or 5 VME/VXS/PCI-X/PCI Express/IBM Blade main boards
- JTAG, ChipScope, and Serial Port access
- Proactive thermal management system. Available in both commercial and industrial temperature ranges
- Full CoreFire Board Support Package for fast, easy application development and technology refresh
- VHDL model, including source code for hardware interfaces
- Includes one-year hardware warranty, software updates, and customer support. Reduce risk with COTS boards and software
- We offer training and exceptional special application development support, as well as more conventional customer support
- Annapolis is famous for the high quality of our products and for our unparalleled dedication to ensuring that customer's applications succeed

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For more information, contact: wfinfo@annapmicro.com **RSC# 35976 @ www.industrial-embedded.com/rsc**

Editor's Choice Products

INDUSTRIAL EMBEDDED SYSTEMS Editor's Choice

Make sense out of taps

We've been covering MEMS accelerometers for quite a while, and we've been looking for companies to do something interesting by embedding processing directly on the sensor module. Kionix has introduced the KXTF9 with an integrated feature called Directional Tap/Double-Tap detection.

Algorithms on the sensor create up to 12 tap-enabled commands for OEM-specified functions. The sensor detects quick, light taps or double taps on any of the six faces (±X, Y, and Z) of an object and computes the event and direction. This information can be used to create unique user interfaces in devices.

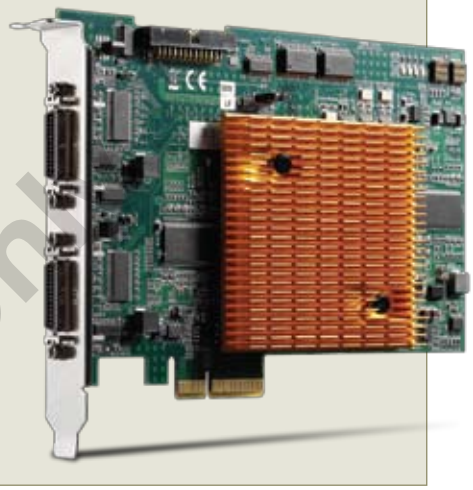
Kionix
www.kionix.com
RSC# 41796

Grab frames with fewer wires

The Camera Link specification was recently enhanced to incorporate Power over Camera Link (PoCL), which as the name implies allows power to be delivered to a camera over the Camera Link cable without the need for a separate power connector. A Safe Power mode determines if a camera is PoCL compatible and only delivers power if it is.

The ADLINK Technology PCIe-CPL64 frame grabber supports PoCL with two channels providing data transfers up to 4.0 Gbps and pixel clock rates up to 85 MHz. It also supports 64-bit operating systems for large address space vision applications.

ADLINK Technology
www.adlinktech.com
RSC# 41798



Get data outside

National Instruments recently announced additions to its line of Wi-Fi data acquisition modules. In thinking through the solution for customers, the company introduced new IP54-rated enclosures for those modules, enabling any of the Wi-Fi DAQ devices to be installed in harsh environments.

The NI 9921 is a low-cost enclosure allowing the antenna and I/O through, while the NI 9922 (pictured) adds an Ethernet port and a 4-pin trigger connector for more control, with all ports protected from both dust particles and splashing water from all directions.

National Instruments
www.ni.com
RSC# 41797

See data outside

Once data and images are acquired, showing them is important, and that display might be located in a harsh environment. Stealth Computer's new TT-840 comes to work with an IP68 rating (immersion proof) and an 8.4" sunlight-readable LCD.

The display is 1,000 nits bright with a contrast ratio of 600:1. It also has IR touch-screen technology, which works in wet, vibration-prone environments. The unit is powered with 12 to 36 VDC and has power, video, and USB connections via rugged circular connectors.

Stealth Computer
www.stealth.com
RSC# 41799

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Industrial device manufacturers have been deploying TeamF1's embedded networking and security software in their products since 1999. From **Ethernet switching** and **management security** software components to complete turnkey **802.11 AP** and **secure gateway/router** firmware, TeamF1 can provide industrial device manufacturers with **advanced connectivity and security** without sacrificing **robustness** and **scalability**. If you are developing intelligent, connected devices for the industrial market, contact us today and learn more about how TeamF1 can extend your legacy devices and be the cornerstone of your next generation ones.

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Create Your Own PMCs

Custom I/O as Easy as 1, 2, 3!

The Technobox ***Micro Mezzanine System***™ is based on a simple idea – provide embedded systems designers with a foundation for innovation and flexibility. Provide a highly-granular, modular architecture featuring a range of configurable FPGA-based carrier boards and an extensive variety of micro mezzanine Electrical Conversion Modules (ECMs) that can be assembled in thousands of combinations. Provide an environment in which a designer can create an array of unique, *future-proofed*, board-level solutions. But without the costs normally associated with custom board development and manufacture, while speeding development and reducing time to market. It's the logical next step in mezzanine systems.

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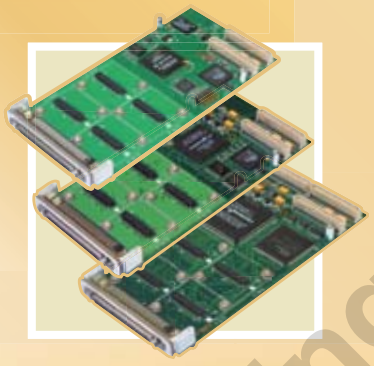
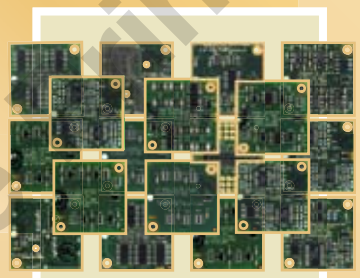
1 **Select an FPGA-based Carrier**



2 **Choose I/O Conversion Modules**



3 **Assemble with IP Core and ECM Code**

Patent Pending

- *Build Your Own Board by Mixing and Matching Modular Components*
- *Thousands of Possible Combinations*
- *Flexible, FPGA-based, Patent-pending Architecture*
- *Incorporate Multiple Functions on a Single Board*
- *Design and Build Application-specific, Future-proofed Solutions*
- *Accelerate System Development, Reduce Time to Market*

To learn more about the Technobox Micro Mezzanine System, visit:
www.technobox.com/mmsintro-fp.htm

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